NOVEMBER 1945

WIRE AND WIRE PRODUCTS

Serving

THE WORKADAY WORLD with FLEXIBLE ADAPTABILITY

This typical Vaughn British installation, which has been operating 24 hours a day, 7 days a week since 1939, is now meeting without interruption the heavy production requirements of peace—representative of the engineered ability of Vaughn Machinery to produce continuously for every demand, at home or abroad.

Vaughn

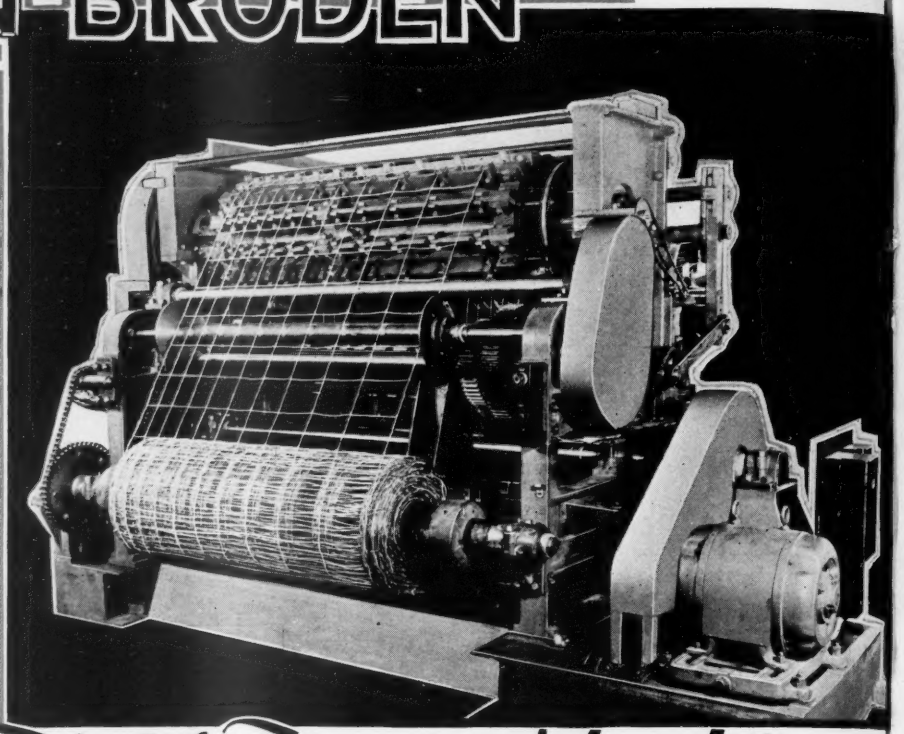
MOTOBLOC and MOTOBLOX

THE VAUGHN MACHINERY COMPANY
Cuyahoga Falls, Ohio

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

WEAN-BRODEN

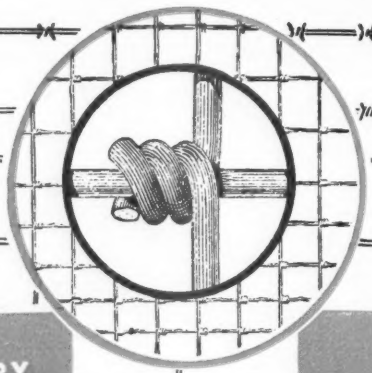


NOW farmers have the money to buy what they need to make their farms easier to manage and more productive. And what practically every farmer needs is fence – fence for cattle, sheep, poultry, and gardens – from thousands of feet to miles per farm.

WEAN-BRODEN FIELD FENCE MACHINES will make all types of farm fence faster and require less maintenance.

All machines are arranged for individual motor drive; working parts are of high grade tool steel; many noteworthy improvements are incorporated to make better fence at highest production rate.

Field-Fence Machines



COLD ROLLING MACHINERY
For 36" Wide Material and Narrower
• Reels • Slitters • Levelers • Coilers •
Scale Breakers • Shears • Scrap Ballers
Mills • Edgers • Continuous Pickling

WIRE MILL EQUIPMENT
Wire Drawing Machines • Patenting •
Galvanizing and Tinning Take-Up Frames
Nail Galvanizing and Blueing
Wire Flattening • Spoolers

The BRODEN CONSTRUCTION Co., Inc., Cleveland, O.
A SUBSIDIARY COMPANY OF
The WEAN ENGINEERING Co., Inc., Warren, O.

HOLMQUIST BARBED WIRE *and* **WIRE FENCE MACHINERY**

Free Detroit Training Course for Your Die Room Men!

You are invited to send your die room personnel to the free training course operated by Carboloy Company at its headquarters in Detroit. This course, consisting of actual shop training under the personal guidance of experienced carbide die specialists, is designed to thoroughly train your personnel in all phases of carbide die servicing.

Close to 100 mills have already taken advantage of this free service, with outstanding results in terms of greater die economies and more efficient die room operation. We stand ready to extend these advantages to your mill also. For complete details, write for booklet D-115.

CARBOLOY COMPANY, INC.

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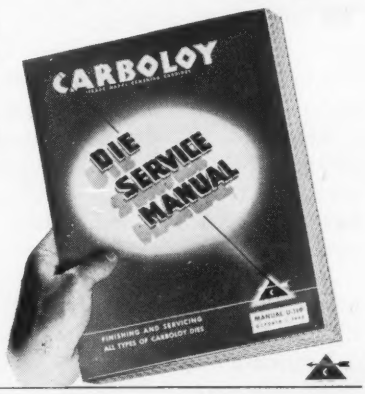
Help for you "at home" too!

New 64 page manual—Die Service Manual—just published contains a wealth of practical help you'll want for every man in your die room. Copies gladly sent, on request.



CARBOLOY (TRADE MARK) *Die* **SERVICE** CEMENTED CARBIDE

What happens to the zinc coating when you bend or twist bethanized wire severely, or draw it through dies to a fraction of its original size? Nothing happens—the coating doesn't flake, peel or chip. And here's why.

Bethanized wire is made by an advanced electrolytic process which actually *locks* a coating of 99.9 per cent pure zinc to the steel base wire. So smoothly and tightly does the zinc adhere to the steel that the two metals become virtually one.

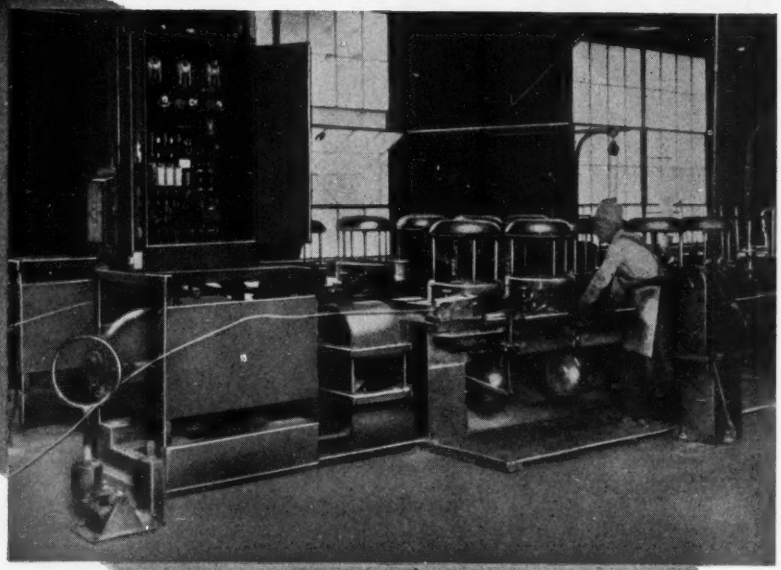
As for ductility, there the bethanized coating scores again, for it can stand any forming operation the wire itself can stand.

Because it's applied electrolytically, the protective bethanized coating is completely uniform both around and along the wire—there are no thin spots in the coating where rust may get a start. Where exceptional corrosion-resistance is desired, bethanized coatings can be obtained up to three times as heavy as those specified in conventional Type 3 galvanizing.

If you use galvanized wire in your manufacturing operations, make it a point to give bethanized wire a workout at your first opportunity. You're likely to find it exceeding your highest expectations for zinc-coated wire. For additional information, simply call on the nearest Bethlehem district office, or write direct to Bethlehem Steel Company, Bethlehem, Pa.

★ BETHLEHEM STEEL ★ Bethanized Wire ★

Satisfied with Your Present Drawing Lubricants?



Get in Touch with Headquarters for Wire Drawing Lubricants

Is die life long enough on all your drawing operations to satisfy you?

Are you getting the finish you'd like to on all your wire?

Are scratches and dullness giving you any concern?

Are you getting the drawing speeds you want, particularly on today's rush schedules?

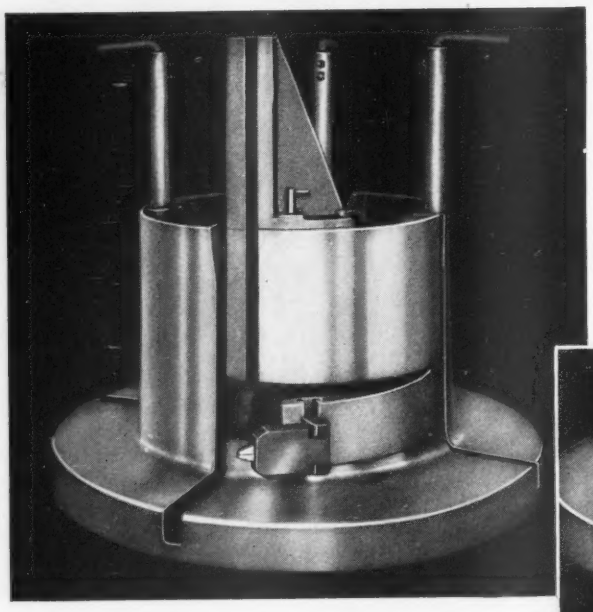
One of the standard Magnus Drawing Lubricants may give you better results than you are now getting. It will be well worth your while to investigate this possibility, because each item in the present Magnus standard line was originally developed to solve a particular drawing problem or problems. This line now covers all types of metals and all kinds of drawing operations, wet, dry and grease. However, if none of these proved compounds is capable of improving results, Magnus is ready to work in close cooperation with your engineers in developing a tailor-made material suited to your own individual needs.

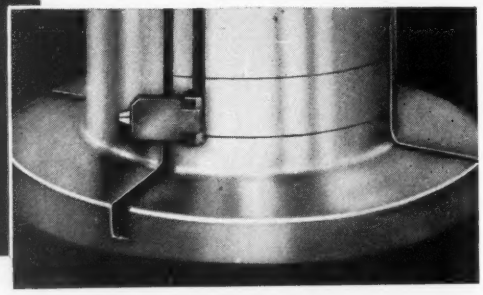
Won't you give us an idea of the improvements you'd like to see on any particular drawing problems? If one of the standard Magnus materials is not applicable, we will work out a special material for you.

Magnus **MAGNUS CHEMICAL CO.** 188 SOUTH AVENUE, GARWOOD, N. J.

Wire Drawing Compounds

The Syncro Automatic Pull-In Starting Clamp





...SAVES TIME
...SAVES LABOR
...ELIMINATES SCORED DRAWING BLOCKS

The Syncro Automatic Pull-In Starting Clamp increases the production of Rodblocks or similar heavy drawing units, and it eliminates costly scoring of drawing blocks caused by starting chains or cables. For with this device, no starting chains or cables are employed.

At the start of the operation, the clamp is held firmly in a section of the block which swings outward so the clamp is in line with the drawing die. As the block revolves, the movable section swings inward until it is flush with the block, which places the clamp in a slot extending to the top of the block. Successive coil convolutions push the clamp upward, and at the end of the operation, the clamp is at the top of the block where it is accessible.

The Syncro Automatic Pull-In Starting Clamp increases production because after the unit has been started, it continues without interruption for the removal of a starting chain or cable, until the coil is completed. It is a valuable feature of Syncro Rodblocks, and interchangeable blocks incorporating this device can be furnished for existing bull blocks or other heavy drawing units. Write for complete details.

SYNCRO MACHINE COMPANY

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CHICAGO 6, ILL.

REPRESENTED IN CANADA BY
CANADIAN ELEVATOR EQUIPMENT CO.
TORONTO

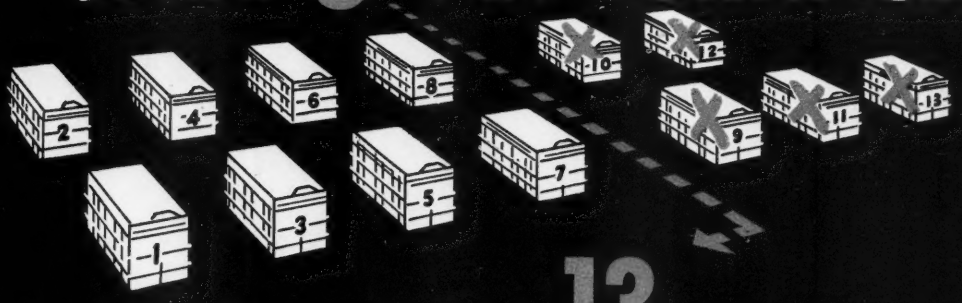
EXECUTIVE OFFICES AND GENERAL WORKS—611 SAYRE AVENUE, PERTH AMBOY, N. J.

Machinery for the Wire Industry

SYNCRO

WIRE & WIRE PRODUCTS, Vol. 20, No. 11, November, 1945. Executive Office, 300 Main St., Stamford, Conn. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Sec. and Treas. Publication office, 206 Summer St., Stamford, Conn. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Stamford, Conn., Feb. 9, 1945, under Act of March, 1879.

Where 8 FEI FURNACES



equalled the output of 13 other furnaces

F.E.I.

Direct Fired Cover Annealing Furnaces for coiled strip, tin plate, flat sheets, wire and rod.

Spheroidizing, Normalizing and Bright Annealing Furnaces.

Galvanizing, Patenting, Lead Annealing and Salt Furnaces for the wire industry.

Galvanizing Furnaces for pipe, sheets, and the jobbing trade.

CONVERSION of any existing cover annealing furnaces to F.E.I. Direct Fired System.

● A steel company operating nine Cover Annealing Furnaces needed four additional units—or thought they did—to handle their production.

Upon investigation, F. E. I. engineers made this suggestion: "Let us begin by converting your present units to the F. E. I. Direct Fired System, and by that time you will know exactly how much additional capacity you need, if any . . ."

This plan was adopted, and by the time eight of the old furnaces had been converted, their output had been so stepped up as to equal that of their nine old furnaces plus the four new units they first thought they needed.

Results like these are the rule rather than the exception wherever the F. E. I. Direct Fired System replaces other types of heating equipment. Along with improved quality and minimized investment go space saving, negligible maintenance cost, and fuel economies which are the more appreciated in view of all the other advantages gained.

Write us for information and recommendations

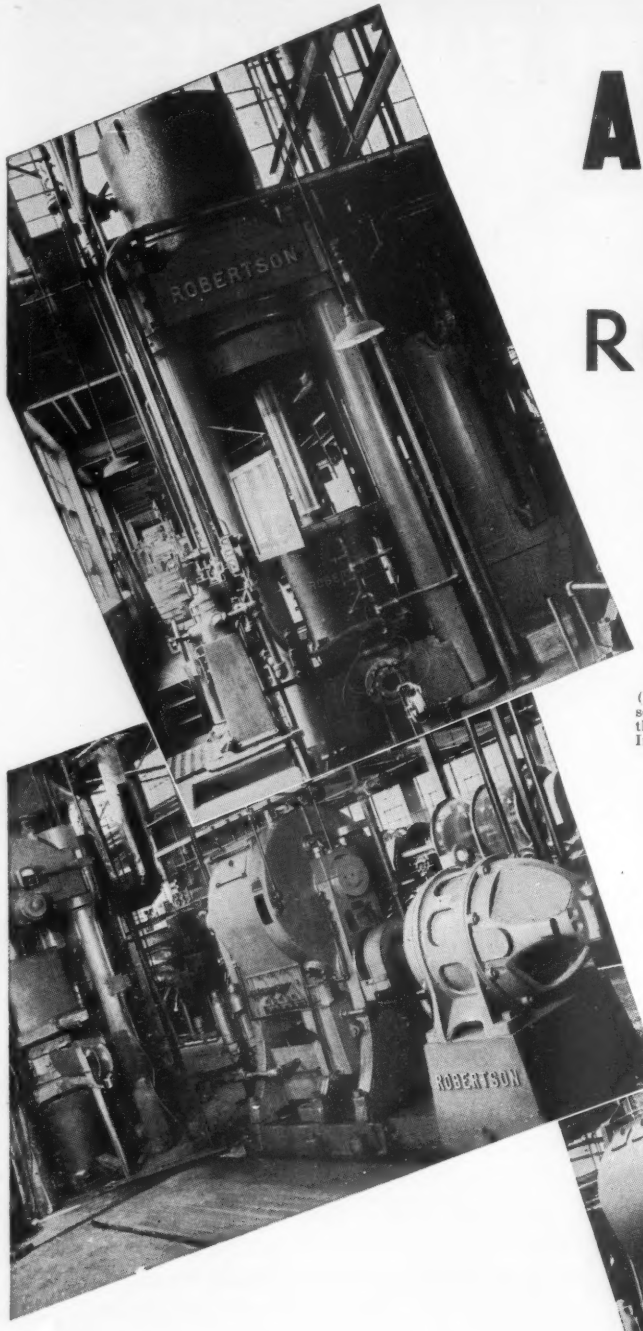
FURNACE ENGINEERS, *Inc.*

Specializing in the design, manufacture and installation of furnaces for the metal working industries

1551 WEST LIBERTY AVENUE ★ PITTSBURGH, PA.

ANACONDA
chooses
ROBERTSON

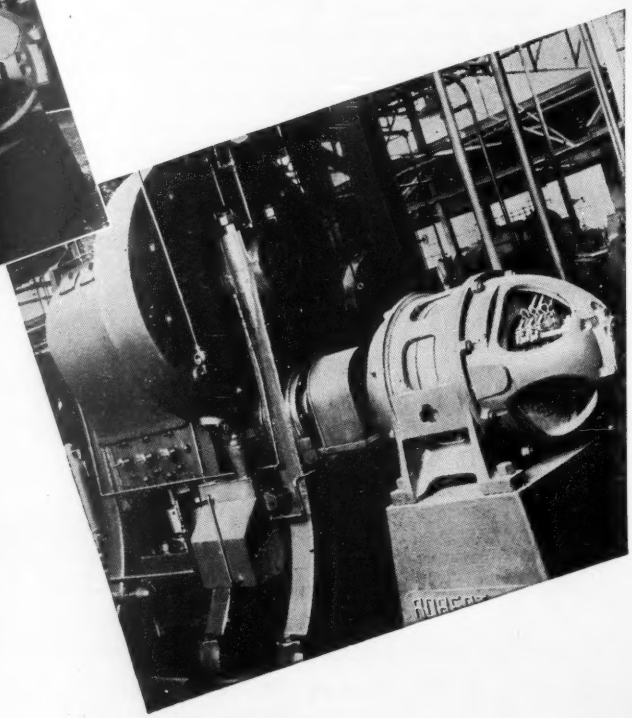
As a man is judged by the company he keeps, so a manufacturing concern is judged by the type of business it attracts and the organizations it serves. It is a significant fact that the majority of the leaders in the field of lead-encased wire and cable use Robertson equipment. The Anaconda Wire and Cable Co., has been among those leaders we have been privileged to serve, again and again. The pictures on this page show a few Anaconda installations of Robertson-engineered equipment.



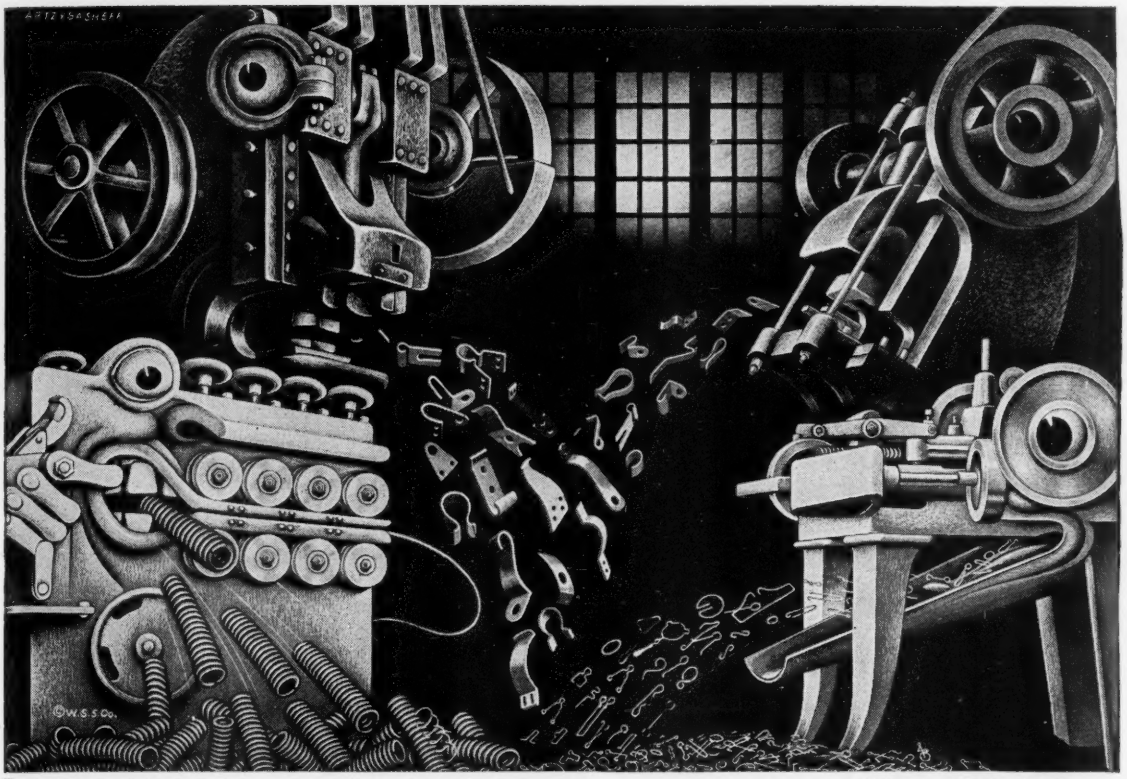
(Left, above) 2,500-ton Robertson lead cable encasing press at the Anaconda plant in Marion, Indiana.

(Left, center) 1,000-ton Robertson lead cable encasing press equipped with Robertson No. 50 triplex plunger hydraulic pump.

(Below, right) No. 80 Robertson triplex plunger pump to operate the 2,500-ton lead cable encasing press shown above.



JOHN Robertson
COMPANY INCORPORATED
125-135 WATER STREET, BROOKLYN 1, NEW YORK
Designers and Builders of all Types of Lead Encasing Machinery
Since 1858



Tenth of a series of Artzybasheff's impressions of the manufacture of steel wire products. *Enlarged reproduction free on request.*

ARE YOUR WIRE CHEWERS CONTENTED?

Wire-working machines are sensitive "creatures." Feed them wire of the right size, tensile and stiffness and they'll gobble it merrily and turn out a lot of work. But give them defective wire and they'll balk.

If you produce springs you may require a strong, tough, hard drawn or tempered wire. Or, if you make wire forms, the job may call for a soft, ductile wire for severe forming before hardening. In either case Wickwire Spencer can meet your needs.

It's an art to select a wire of exactly the right carbon content so that it will work well and serve the purpose for which it's intended. This art is something that Wickwire Spencer's metallurgists and mill men have acquired through long years of experience.

Our metallurgists, whose services are yours for the asking, will gladly study your wire problems and determine the best wire for your needs. And, whether you buy in moderate amounts or in carload lots, you may be certain that every detail in manufacture will be carefully controlled to make sure that the wire you order will meet your specifications.

Everything you need in steel wire is here at Wire Headquarters in a wide variety of sizes, tempers, grades and finishes; high or low carbon; round, flat or shaped. Ask a Wickwire Spencer engineer to call at your convenience.

Send your wire questions to

WICKWIRE SPENCER STEEL COMPANY

EXECUTIVE OFFICES—500 FIFTH AVENUE, NEW YORK 18, N. Y.

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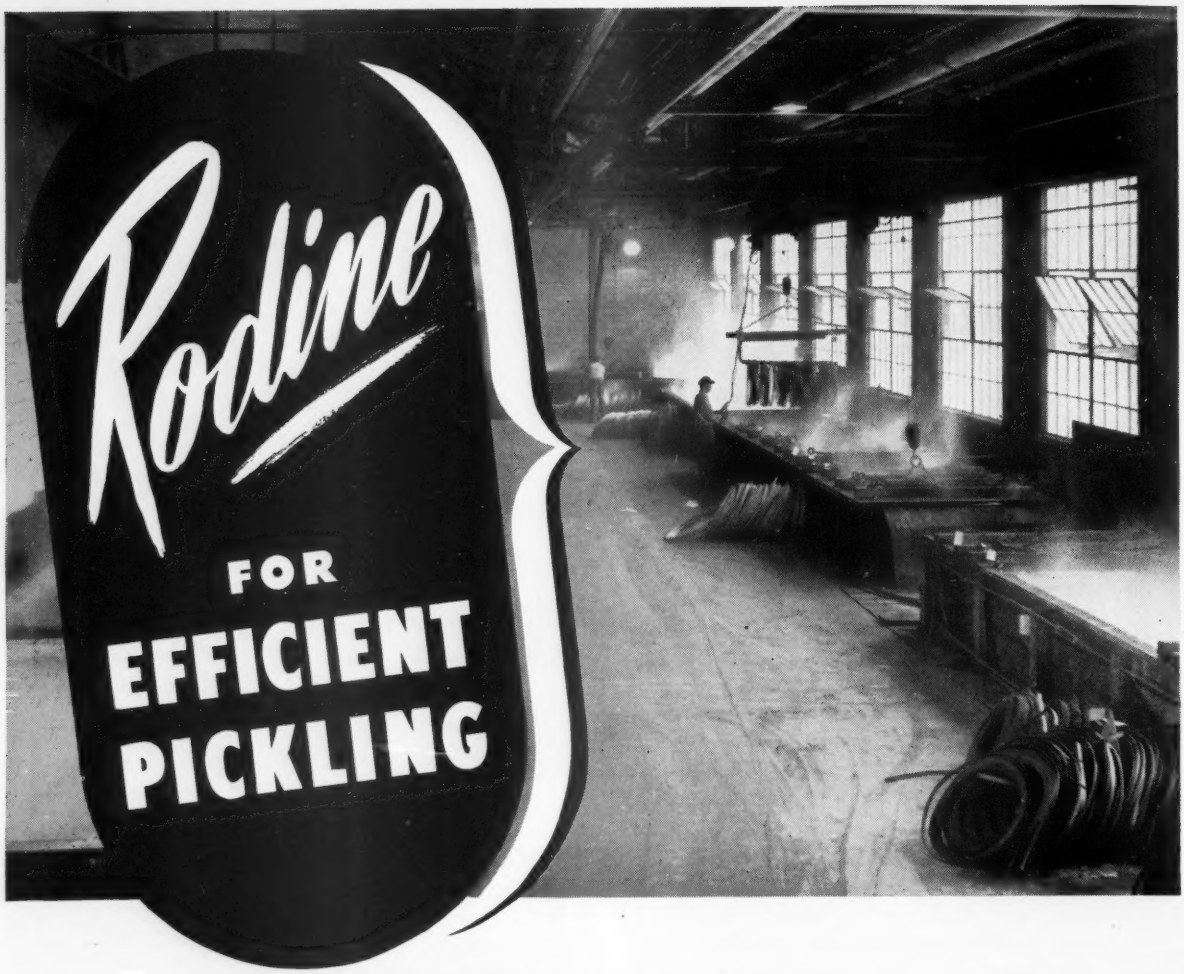

The dollars saved by efficient pickling with RODINE may represent the profit balance in keenly competitive markets — especially in peacetime production.

The savings in pickling costs resulting from the use of RODINE in the pickle bath are many times the cost of the Rodine used.

RODINE, a selective inhibitor, will show a material saving in acid required to remove scale and at the same time prevent the acid from dissolving clean metal. A better finish also is produced.

Here are a few of the many advantages of the RODINE inhibited pickle bath:

- Less tonnage dissipated in pickling
- A given weight of metal requires less acid to pickle
- Acid not wasted destroying clean metal
- Cuts loss, due to rejections
- Surfaces not acid pitted
- Overpickling eliminated
- Metal not embrittled or burned

There are types of RODINE suited to the varying pickling problems. The experience of ACP Technicians and Laboratories is at your service to recommend the Rodine application best suited to your needs.

CUPRODINE

Now Available
for *Coating Stainless Steel*

Stainless steel may now be copper coated in the CUPRODINE bath, by simple immersion, as efficiently as ordinary iron or steel.

Write for CUPRODINE Service Data Sheet to Dept. D-11.

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PRODUCERS OF FINE WIRES IN ALL METALS

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Cadmium, Nickel Silver, 10%, 18% and 30%; Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification, Metallic Fibre for Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum.

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Pure Lead, Lead Alloy, Pure Zinc, Zinc Alloy, Copper, Tin, High Brass, Low Brass, Solder Wire, High Conductivity Electric Wire.

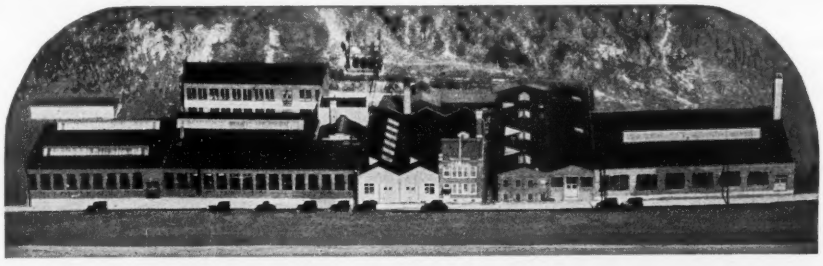
Cadmium, Nickel Silver (10%, 18%, 30%), Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel, Commercial Bronze.

Look for the name — HUDCO — A guarantee of quality

"HUDCO" specially processed Copper Wire for enamelling purposes is drawn from Selected Copper, insuring the maximum conductivity. This is but one example of the use of the most advanced and approved materials and methods in our processing.

BETTER WIRE AT LOWER COST

Write for Prices and Samples • Let Us Quote on Your Requirements

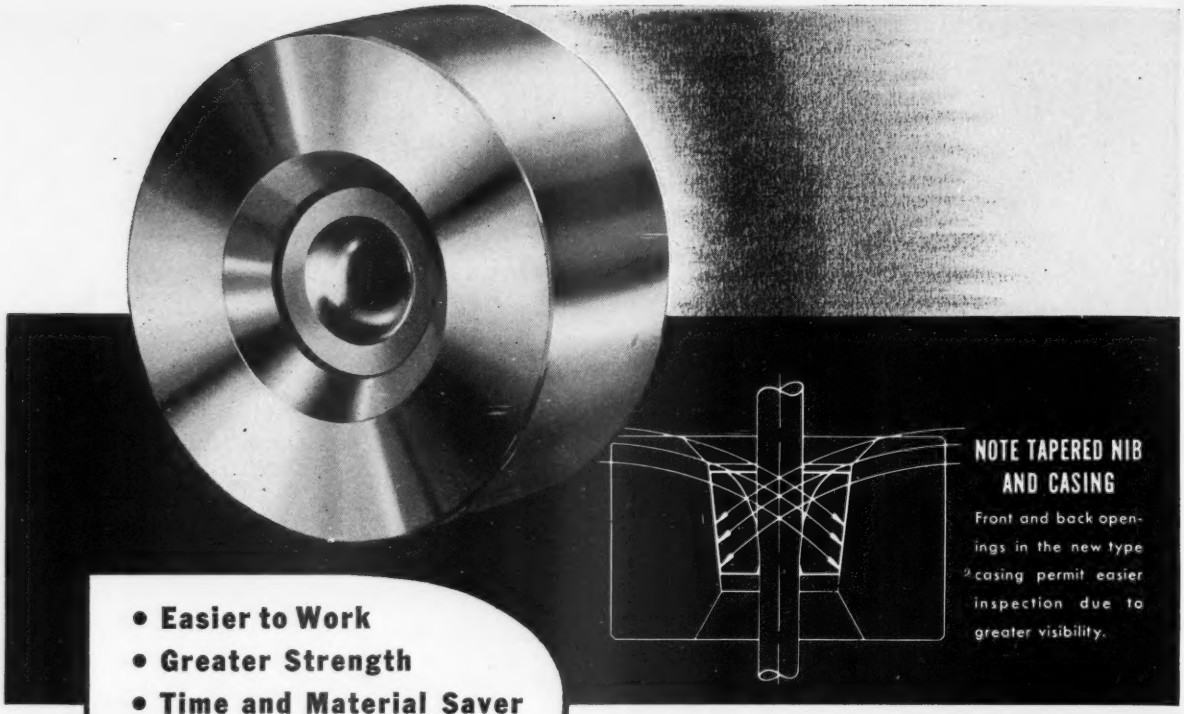


"HUDCO" PLANT AT OSSINING, NEW YORK

HUDSON WIRE COMPANY

Established in 1902 — Successors to Royle & Akin

OSSINING, NEW YORK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Front and back openings in the new type casing permit easier inspection due to greater visibility.

- Easier to Work
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- Time and Material Saver
- Better Lubrication
- Full Visibility

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Tantalum/Tungsten

Carbide Dies . . .

. . . for Drawing Wire, Bar and Rod

A BOOK ON STANDARD ROUND HOLE DIES just off the press will be helpful to you. Write us for Bulletin VR348.

Maintain size longer and produce better finish. Tantalum/Tungsten Carbide has a lubricating characteristic which greatly reduces mechanical resistance in drawing, and in so doing, enables a much smoother finish. Many mills report longer productive life, less down time, greater tonnage per die and greater operator satisfaction.

4533

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An Affiliate of Fansteel Metallurgical Corporation and Vanadium Alloys Steel Company
NORTH CHICAGO, ILLINOIS • SALES AND SERVICE IN PRINCIPAL CITIES

ALCOA has available skilled servicemen to assist automatic screw machine operators. Faced with an unusual problem concerning aluminum, they pitch right in to help your operators solve it. You get the job under way quickly.

Years devoted to developing and producing aluminum alloys for fast, smooth, automatic machining have given Alcoa a wealth of experience. Alcoa's own screw machine department has enabled us to put it to practical use. With this knowledge Alcoa servicemen will call to help with your problems.

Many machine operators are now experienced workers with aluminum. When you need help, Alcoa's servicemen are ready to step in and give whatever advice you need. For this help, call our nearest office or write direct to ALUMINUM COMPANY OF AMERICA, 1828 Gulf Building, Pittsburgh 19, Pennsylvania.

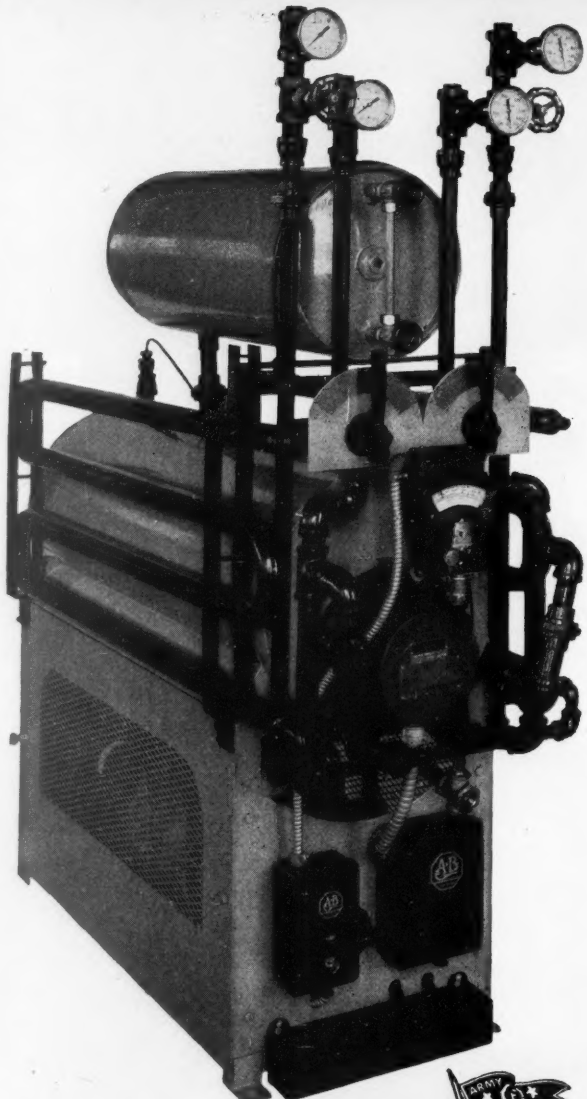
. . . say the word and

we'll roll up our sleeves

ALCOA FIRST IN ALUMINUM

Extruder Temperature Control Unit

- Wide temperature range available
- Sustains high or low extruding temperatures
- Supplies or removes heat from extruder as required
- Multiple circuits can be accommodated
- Hand lever selection of pre-determined extruding temperatures
- Available in two sizes
- Compact



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to finish these 5-year-old B&W Insulating Firebrick

If you were to read through the service reports on B&W Insulating Firebrick, you might be surprised to learn how long these brick stand up. Case after case shows five years' life where only two or three years' life would be expected or had been realized with other brick.

There are a few spectacular cases too. For instance, the large stress-relieving furnace that was lined with B&W Insulating Firebrick that stood up for five years—still in excellent condition—and failed only because an explosion wrecked the furnace.

Naturally, the same B&W Insulating Firebrick were ordered for replacement. And here again B&W Refractories Service came to the rescue on a vital rush job. The order, phoned to the nearest B&W office on a Saturday, was shipped the following Monday.

A notable—and characteristic—example of B&W dual service; service in the product, service in emergency deliveries. And an excellent reason why it will pay you to specify B&W.

R—218

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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CAPSTAN UNITS

We offer a complete line of capstan units of both the double drum type and the single drum type with grooved idler fleeters as illustrated.

These capstans are designed to suit every purpose, and the units are used in connection with insulating equipment of various types or with stranding and cabling equipment.

Variation in speed by either change gears or by variable speed transmissions.

Sizes from 14" diameter to 96" diameter.

Let us design a capstan unit to meet your requirements.

Write for details.

NEW ENGLAND BUTT COMPANY

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PROVIDENCE 7, RHODE ISLAND, U. S. A.

James Day (Machinery) Ltd., "Ford House," 88 Regent St., London., W.I., England

Stancoat

LICENSED UNDER U. S. PATENTS

for WIRE COATING

NOW AVAILABLE in Sufficient Quantities to Meet Increased Demands

Stancoat has been compounded to replace lime and other similar coating materials used in drawing of rod or wire.

STANCOAT POINTS OF ADVANTAGE

1. Use one pound or less per ton.
2. Die life increased over use of lime coating.
3. Percentage of rejections due to scratching, out-of-round, or off-size reduced to fraction of 1%.
4. Lubricant cost reduced by one-third or more.
5. No dust created so air and machines remain clean, and great improvement in working conditions is obtained.

Although STANCOAT costs considerably more than lime, it has been found that the total saving has been offset by the difference between the unit cost of the coatings involved.

Write us for complete instructions of application and testing. STANCOAT is shipped in wooden barrels with an average weight of approximately 300 pounds.

Standardize with Standard

STANDARD INDUSTRIAL COMPOUNDS COMPANY

4600 W. Ferdinand Street, Chicago 44, Ill.

Standardize with Standard

SPECIALIZED RESEARCH EXPERIENCE

In All Types of Insulating Finishes and Impregnating Materials.

All Formulations made to individual specifications and to meet unusual requirements.

Our Hot-melt, Flame-resistant Compounds are non-toxic.

STANDARD VARNISH WORKS

Engineers of Product Finishes

NEW YORK - CHICAGO

SERVING INDUSTRY FOR 75 YEARS

The photograph shows finished rods, still red hot, being reeled into 340-lb. bundles, coiled two at a time. After cooling, pickling and other preparatory processing, the rods are drawn through special dies. At every stage, operations are under close control.

YES, he's a specialist! And like hundreds of other Youngstown wire-mill workers, today he concentrates on a single objective. He works to turn out just as much rope wire for our customers' needs as possible. His keen appreciation and quick eye for quality are sharpened by the close tolerances and high chemical and metallurgical standards which specifications for Yolectro High Carbon Rope Wire require.

With no reconversion problem involved in the manufacture of Youngstown wire mill products, we are happy to say that we can now make wire for you again—as much as you want—to whatever specifications you need—with a sureness for quality and uniformity made all the stronger by these many months of peak production of wire for wire rope for war.

YOLECTRO TRADE MARK YOUNGSTOWN ROPE WIRE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN 1, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Wire-Nails-Tie Plates and Spikes-Pipe and Tubular Products-Conduit-Sheets and Plates - Coke Tin Plate - Electrolytic Tin Plate - Bars - Rods.

An Expression of Appreciation for . . .

Your Co-operation

It is Needed Now More Than Ever

The fine spirit of cooperation that exists between the publishers of Wire and Wire Products and our readers is largely responsible for the high degree of helpfulness that we have been able to extend to our field.

When you, a reader, supply a technical paper covering some of your developments or experiences, you lend a helping hand to others struggling with a problem; but, by the same token, this "bread cast upon the waters" encourages others to supply information that will assist you.

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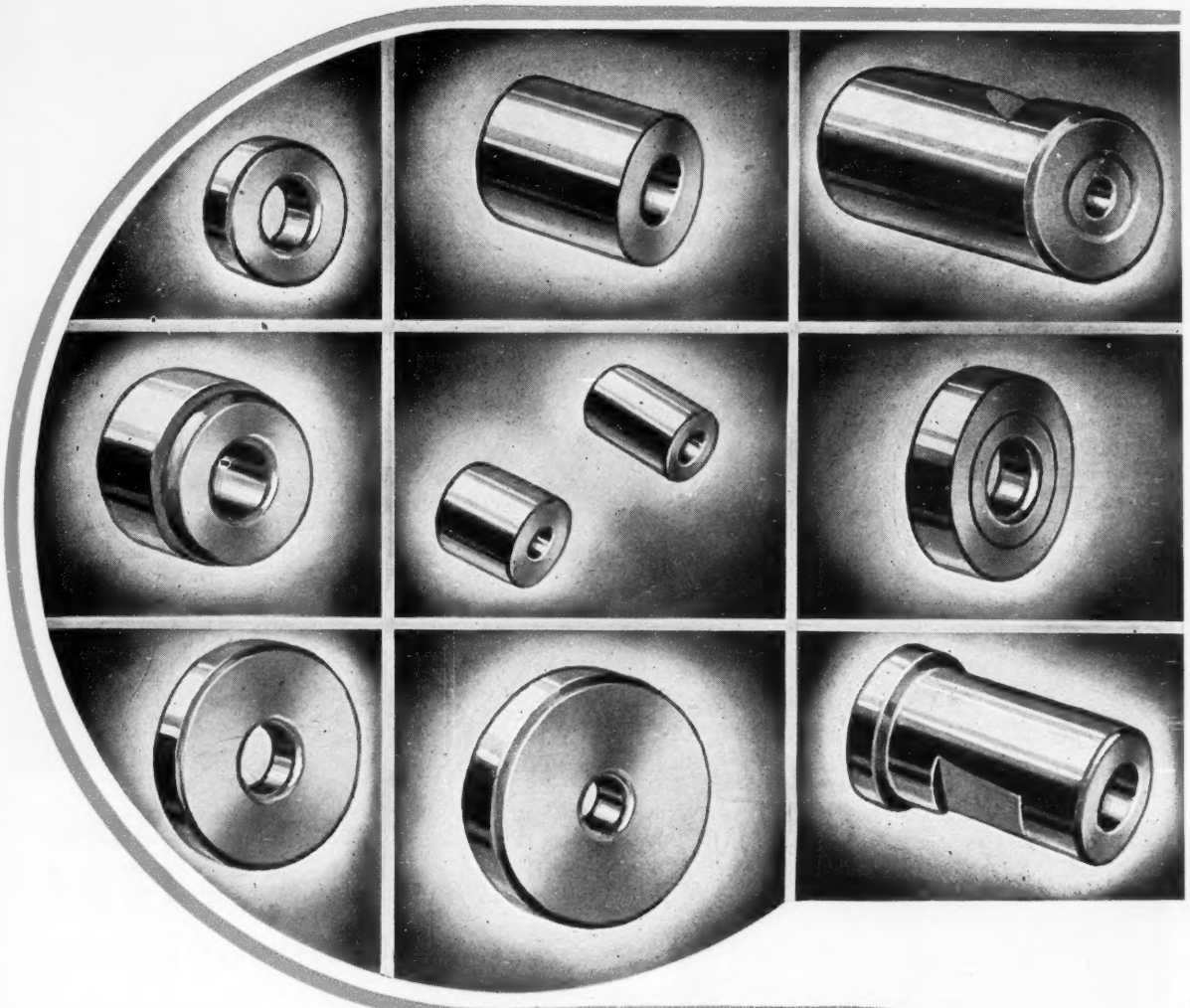

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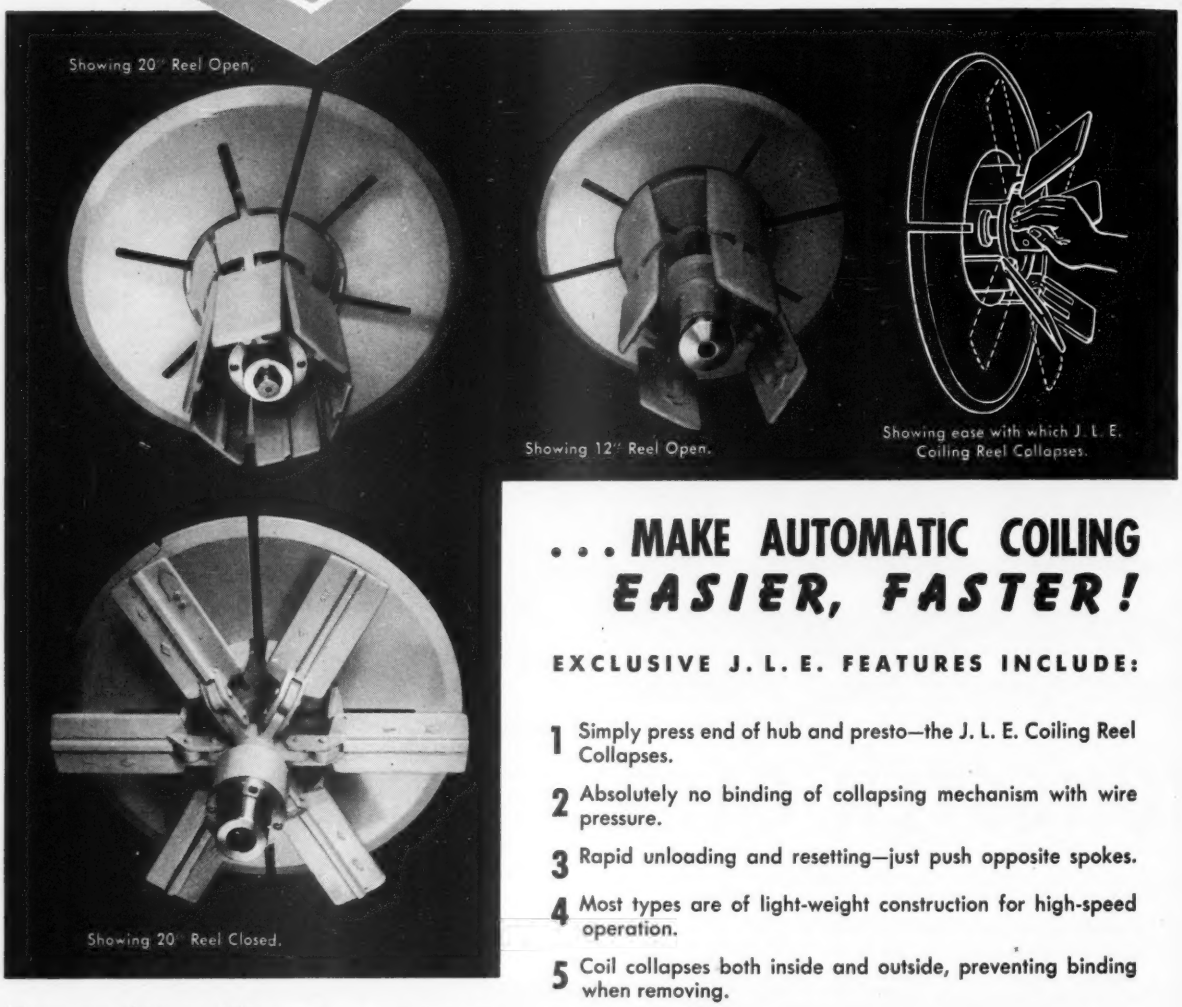

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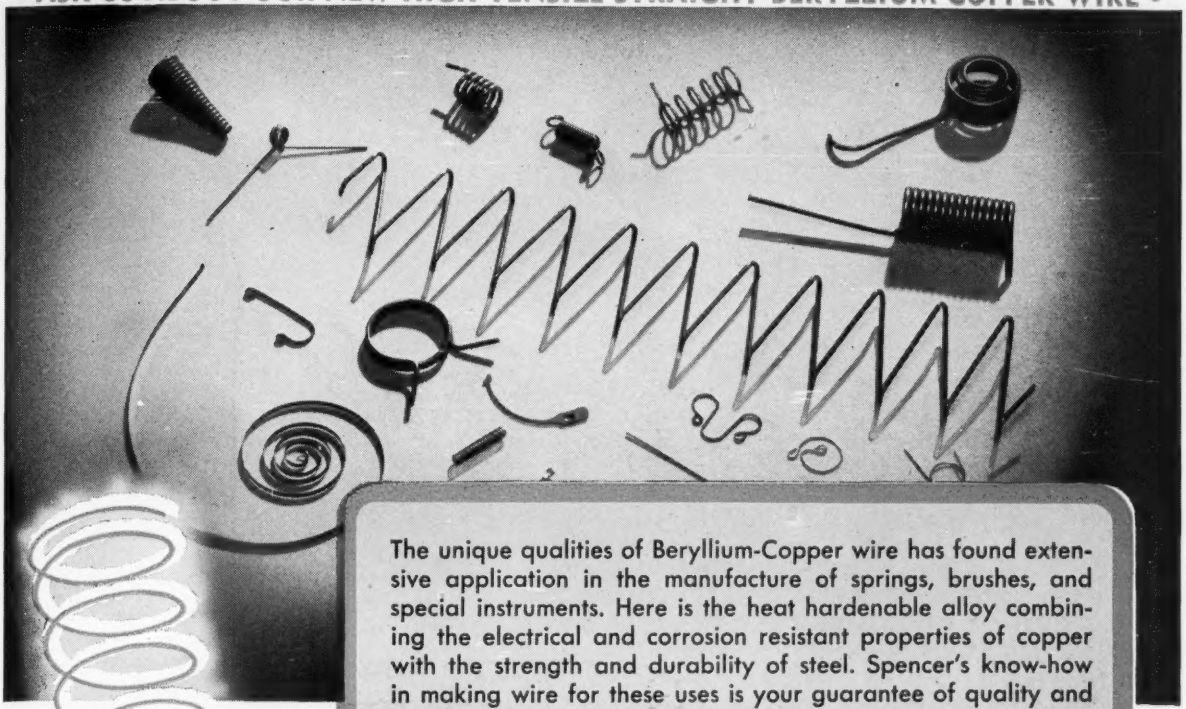

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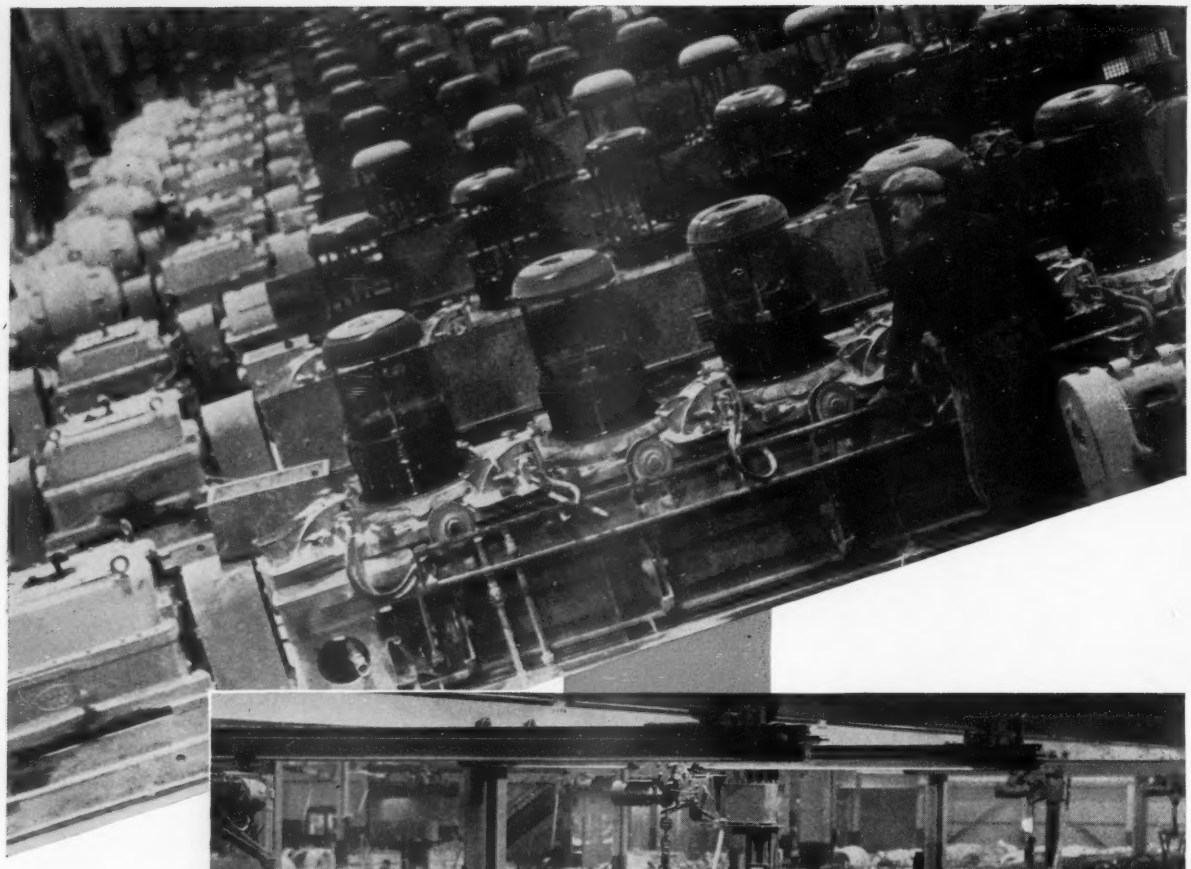

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 20 NOVEMBER, 1945 No. 11

Designated as

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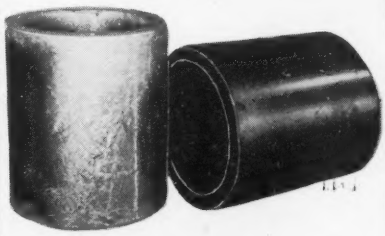

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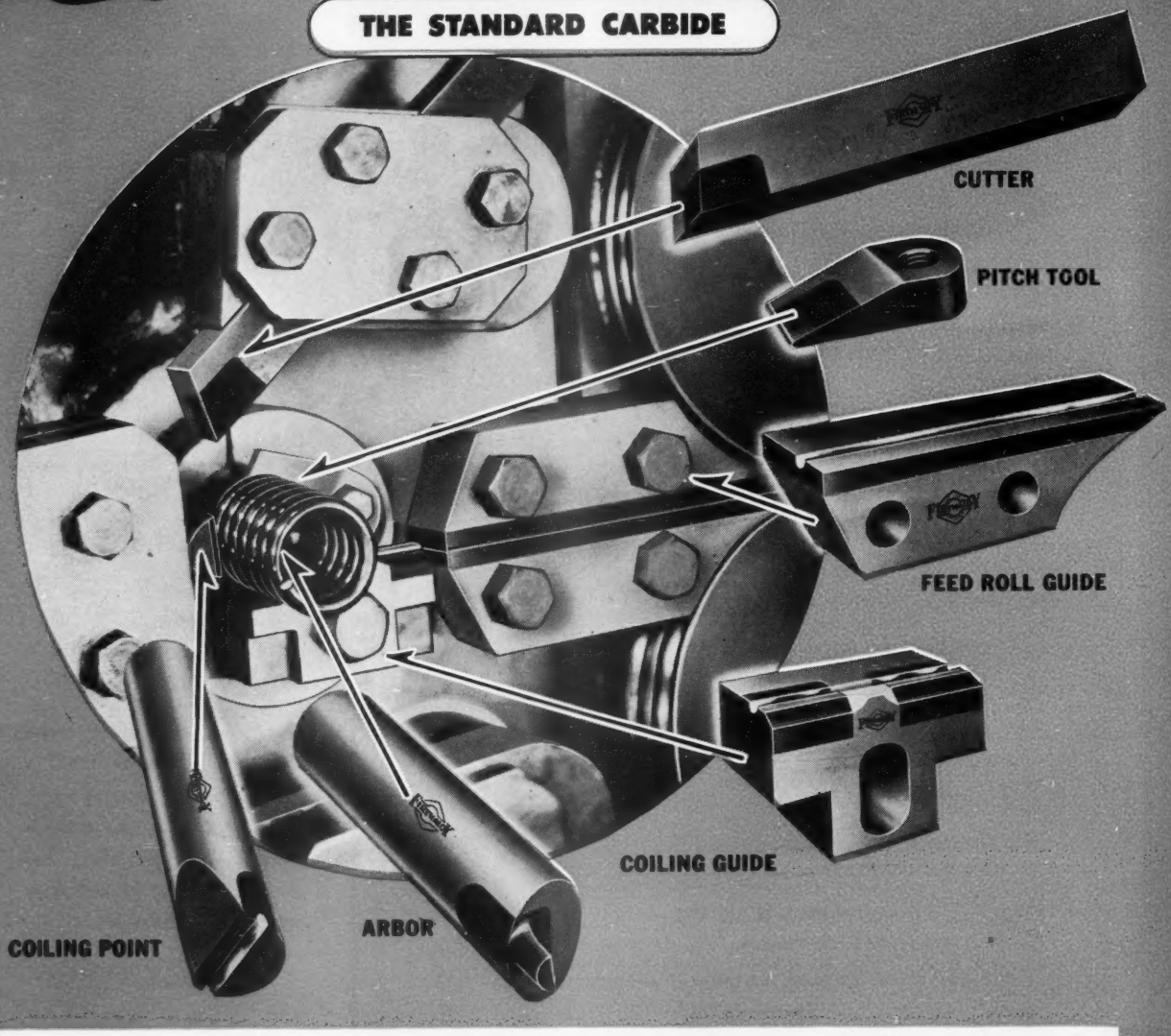

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 20 NOVEMBER, 1945 No. 11

Metallurgy of Copper and Its Relation to Magnetic Wire Manufacture

by W. L. Fleischmann,

Section Engineer, General Electric Company,
Fort Wayne, Indiana

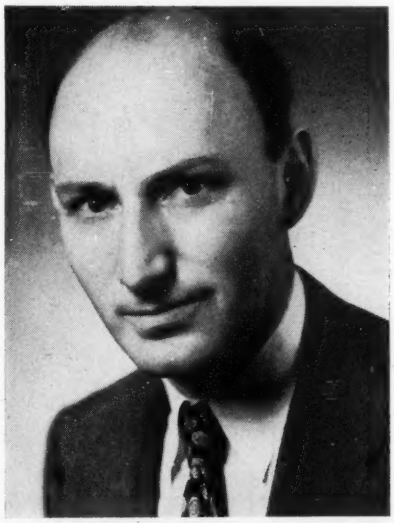
A paper presented at the Wire Association Convention, Chicago, October, 1945. ✦ ✦ ✦

HIGH conductivity materials always have and always will interest metallurgists, especially those connected with the electrical industry. Among these materials, copper, which has proved itself to be the most economical material for many a use, occupies a place of special interest. Copper is used in a great variety of forms, bus bars, switch blades, contacts, bevel bars for commutators, and all sorts of insulated conductors. Though from a production metallurgist's point of view such an enumeration may not appear of any significance, a product metallurgist —these terms were coined by **S. L. Hoyt** (1)* — has to develop those properties which make a material of particular usefulness in answer to the constant demand for improvements in the design of electrical apparatus.

✦ ✦ ✦

OF all the uses of copper in that industry the insulated conductor is its most important application.

*Numbers in parenthesis pertain to the references appended to this paper.



W. L. FLEISCHMAN

Mr. Fleischman was graduated from the Technische Hochschule, Berlin, in 1933 with a degree in Mechanical Engineering. He studied metallurgy there under Prof. G. Sachs and F. Schmid. He joined the student engineers course of the General Electric Company in 1934 and has been with that company ever since. For the last four and a half years he worked in the Ft. Wayne Works Laboratory on metallurgical problems and was transferred just recently to the Turbine Generator Engineering Division at Schenectady. He is a member of A.S.M.E. and A.S.M. ✦ ✦ ✦

From a metallurgical point of view the production of such a conductor becomes more interesting, the thinner the insulation and the lower the baking temperature of the insulating coat. This paper will discuss the metallurgical problems encountered in the manufacture of such an insulated or magnet wire.

✦ ✦ ✦

THE requirements which are to be met by a magnet wire are best understood if wire and insulating film are considered one unit. The manufacturer of electrical equipment, be it a motor or transformer maker, looks at the magnet wire as a means of producing the necessary ampere turns in magnetic structure. To produce the maximum effect in a minimum space the thinnest insulating coat permissible with the safety and durability of the equipment is desirable. In the making of such equipment the wire has to stand rough treatment. It is bent over short radii. No slivers shall puncture the insulation. It must stay put in its designed space and not spring back. The

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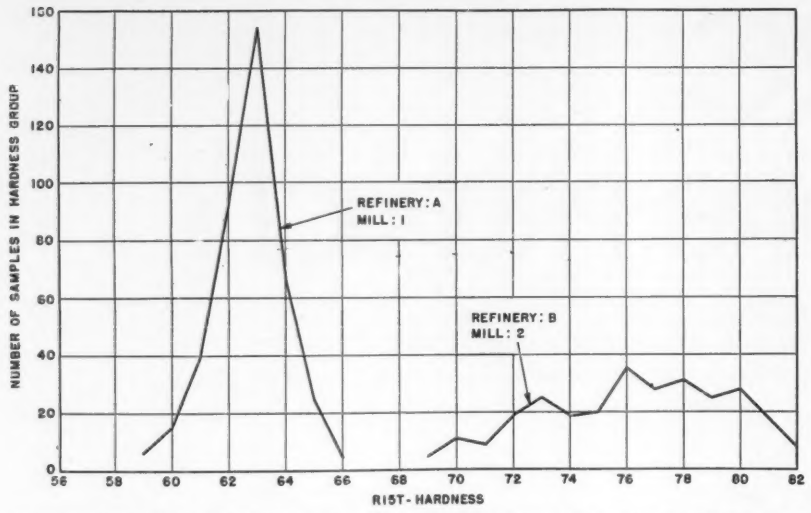

Fig. 1. Hardness of hot rolled tough pitch copper after reduction from ¼" diameter to 0.072" thickness and an anneal in a salt bath for 15 minutes at 275° C.

metallurgist's task is to make possible the production of such a soft, smooth, sliver free wire to which the insulating coat adheres tightly. It might be argued that the making of a sliver free and strong wire is a wire drawing problem, yet the metallurgist is often called upon to determine the origin of breaks and slivers. Therefore it might be worthwhile to survey the steps which have been taken to eliminate those defects and mention for completeness sake some of the causes even outside the metallurgist's realm.

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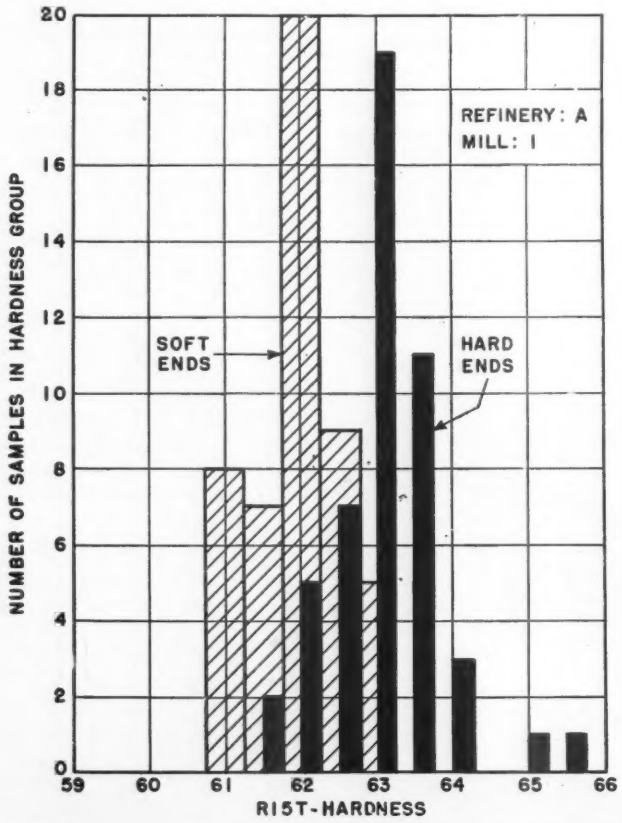

Fig. 2. Hardness difference between the ends of a hot rolled rod. (Testing technique same as quoted under Fig. 1).

FAILURE of small diameter wire in sizes below 0.040 inch diameter occurs sometimes in winding. It is caused by inclusions of foreign matter, usually iron. This is just one of those chance happenings. Other types of failure, the "cup and cone" and the "check marks" type break are produced by faulty wire drawing practice (2). Good control of die angles and careful setup will help to keep these defects to a minimum (3).

✦ ✦ ✦

THE origin of slivers is not so easily determined and their causes are multitude. Rough dies cause scratches which might be ironed out in later stages, but a minute lap might still be left. In bending it might unfold and one end of the lap break loose. A sliver of this type usually has a bright appearing bottom, not oxidized from a hot working operation. Here again good die maintenance will help to overcome these slivers. To eliminate slivers which are produced by the hot rolling of the wire bar into a rod the General Electric Co. has developed the shaving machine (4), in which a 0.005 to 0.01 inch thick layer is taken off the hot rolled and pickled rod by a specially designed tool. The surface of a shaved rod is extremely smooth and thus is a good start for a sliver free magnet wire. Another approach to the elimination of slivers has been selected by treating the hot rolled rod chemically prior to picking (5). In this process the rod is dipped into a halide solution prior to a furnace treatment in which the cuprous oxide is transformed in to cupric oxide. This latter oxide is readily removed in the standard sulphuric acid dip while the cuprous or red oxide would be reduced to a powdery tightly adherent copper.

✦ ✦ ✦

HOW far a scalped wire bar contributes to a sliver free wire produced from a shaved rod is difficult to say. Under all circumstances good hot roll practice is essential to produce a good rod no matter whether the wire bar is scalped or unscalped. It is probably safe to assume that the milled off edges of the scalped wire bar are a help to produce a good rod. When a flat wire is to be rolled, it is, however, advantageous to use a scalped wire bar be-

cause an edge produced by the oxide rich layer has a tendency to show signs of cracking and would be rough, a poor base for any insulation.

✦ ✦ ✦

THOUGH sliver and dust removal is of real importance to the operator and customer, to the metallurgist the annealing behavior of tough pitch copper is of greater interest as one of the fundamental properties of a metal.

✦ ✦ ✦

IT has long been recognized that tough pitch copper rod from various refineries and hot rolled by different mills does not respond uniformly to a standard annealing cycle after a definite amount of cold work. Yet as with so many properties, it is rather difficult to decide whether the annealing behavior of one particular shipment of hot rolled rod is an invariable of the whole lot or whether differences within the shipment can be observed. To ascertain this it is necessary to determine the minimum sample size which will then prove statistically the annealing temperature of a certain shipment of copper. The first surprising fact which was brought out in such an investigation is that the annealing response varies by source of wire bar and by hot roll mill. (See Figure 1.)

✦ ✦ ✦

FROM this check in which 404 samples from one source (Refinery A, Mill 1) and 282 samples from other source (Refinery B, Mill 2) were taken it was found that the mean Rockwell hardness was 62.7 R15T with a standard deviation of 1.28, while the other source showed a mean of 76.2 R15T with a standard deviation of 3.28. This great difference between the two lots which even was maintained in successive shipments was not suspected and could not have been detected on a few test samples. This test, however, does not show whether the difference in the annealing behavior is due to variations in composition caused by the use of different blister copper or to hot mill practice. However, the great spread in the annealing response of the copper from Refinery B made it appear unlikely that the difference was due to chemical analysis knowing the care refineries apply in their daily routine.

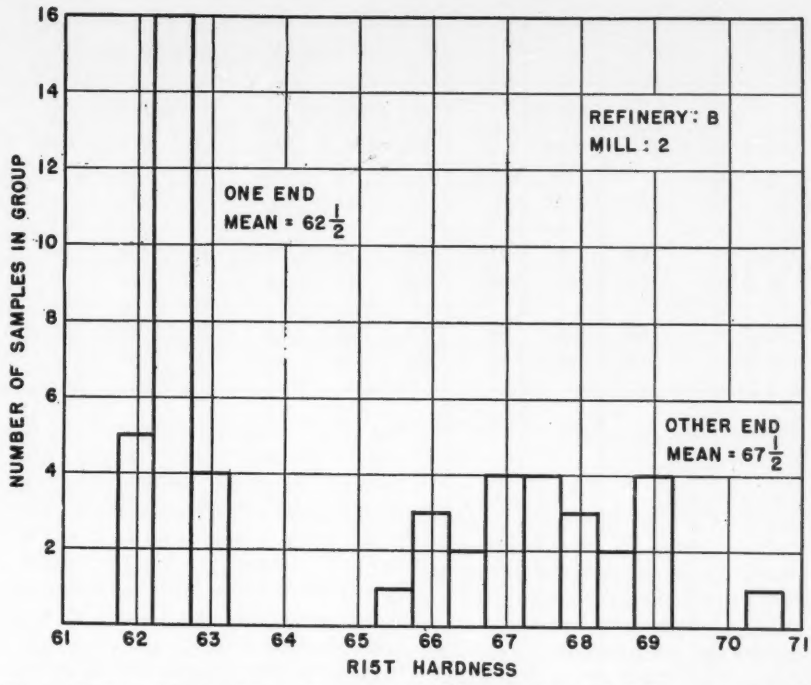

Fig. 3. Hardness difference between the ends. (Note different refinery and Mill). ✦ ✦ ✦

✦ ✦ ✦

IT seemed more likely that differences in the annealing behavior would be due to other factors which might even make itself felt from one end of a rod to the other. Figure 2 and Figure 3 show this difference in annealing behavior between the ends. (The copper used for this test was from other shipments than that shown in Figure 1). A chemical difference could exist between the ends. However this theory has to be ruled out as Refinery A and B both use the Walker type wheel. There the wire bar is cast while the casting machine travels. For the same reason possible differences in the macro structure of the wire bar (6) are ruled out, as no great differences in cooling rate during solidification can

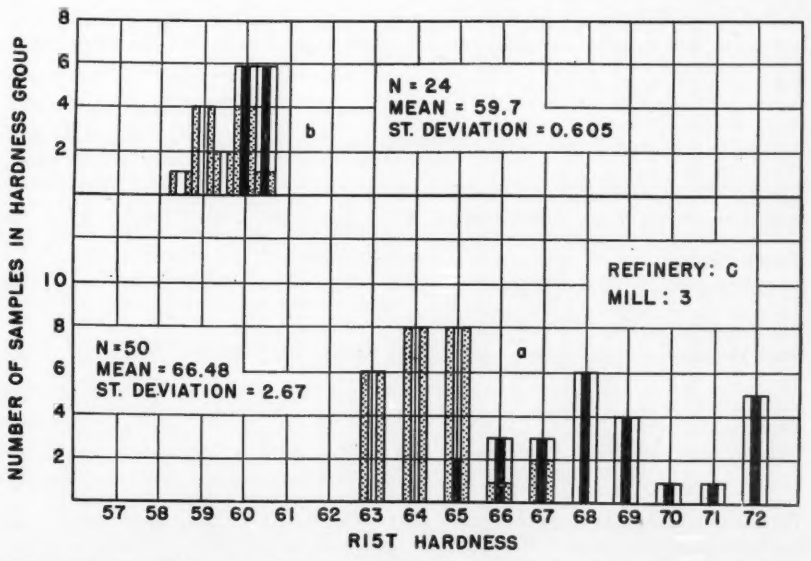

Fig. 4. Effect of "Soak" anneal on Hardness of copper after cold work and annealing: (a) "as received" condition — cold worked and annealed; (b) same lot with 500° C soak anneal for 10 hours, then cold worked and annealed. (Shading indicates different ends.) ✦ ✦ ✦ ✦

TABLE I

RUPTURE STRENGTH

Treatment	24000 Psi Hrs.	Elong. % in 1"	Red Area %	22500 Psi Hrs.	Elong. % in 1"	Red Area %	20000 Psi Hrs.	Elong. % in 1"	Red Area %	18000 Psi Hrs.	Elong. % in 1"	Red Area %	Material
F.C.	0.2	75	71	1.0	56	70	10	38	43	30	31	34	Tough Pitch
W.Q.	0.2	58	68	1.0	43	49	3	36	39	10	29	31	(Low Impurity)
F.C.	0.5	53	54	2.5	43	47	10	36	39	40	30	31	Tough Pitch
W.Q.	0.2	46	47	0.6	39	41	3	30	33	15	24	27	(High Impurity)

exist from one end of the wire bar to the other.

✦ ✦ ✦

THEREFORE other factors outside the refinery must effect the annealing behavior and the one most likely to influence the annealing behavior is the thermal treatment the wire bar and rod receives during hot rolling. That there exists a physical difference in copper caused by cooling rates has been shown in rupture tests (7 and 8). A bar slowly cooled from 800° C. has a greater rupture strength than a water-quenched bar. (See Tables I and II).

✦ ✦ ✦

THESE tests conducted by the **Research Laboratory of the General Electric Company** show the importance of the cooling rate on one particular property of copper. In the light of the investigations published by **Central Research Laboratory of the American Smelting and Refining Company** this erratic annealing behavior of tough pitch copper can be fully explained (9, 10, 11, 12). Depending upon the cooling rate certain impurities present in the copper will exist in a solid solution or as an oxide. In a tough pitch copper rapidly chilled from a high temperature a number of impurities will form a solid solution with copper thus raising its annealing temperature. Slowly cooled tough pitch copper will contain these same impurities as an oxide. The most important result of the research of the American Smelting and Refining Company is, in the writer's opinion, the establishment of the reversibility of the solid solution—oxide process. Elements existing as an oxide can be diffused into the copper by extended heating to 800°-850° C and maintained in that state by a quench. Extended heating between 500°-600° C will oxidize these elements, thus lowering the annealing temperature. In order to establish whether this explanation of the annealing behavior of the commercial tough-pitch, hot rolled copper rod is correct, samples from a shipment of copper were held at length at 500° and 600° C for several hours. The results depicted in Figure 4. show that the differences in annealing behavior of hot rolled copper rod can be eliminated by an anneal at 500° to 600° C, and it can be assumed proven that the great variations in the annealing response of certain shipments of tough pitch copper are attributed to the thermal history of the hot rolled rod.

✦ ✦ ✦

THE faster annealing response is carried through the wire drawing process (Figure 5.). The half hard annealing temperature of the wire made from the rod in the "as received" condition is 173° C, while the wire made from a rod soaked for 15 hours at 500° C has a half hard annealing temperature of 145° C.

✦ ✦ ✦

TABLE II

Chemical Analysis of Copper as listed in Table I and typical analysis of copper today and 20 years ago

Material	Ag	Fe	Fb	S	As	Ni	Bi	Te	Se	Mn	Sn	Sb	°2	Cu	
Tough Pitch Low Impurity	.0015	.0007	.0001	(a) .0013	.0003	.0002	.00001	.0001	—	—	Nil	.0002	(a) .035	99.961	Determined American Smelting & Refining Co.
Tough Pitch High Impurity	.0018	.0006	.0020	(a) .0013	.0004	.0025	.0001	.0001	—	—	.009	.0007	(a) .035	99.947	
Analysis 20 years ago	.001	.0025	—	.002	.0015	.0015	—	—	—	—	—	—	.02 to .05	99.94	Typical analysis
Typical Analysis Series System	.28 Oz./to .00085	.0016	.0009	.0017	.0005	.0011	—	.0007	.001	—	—	.0004	.037	99.962	

(a) Estimated.

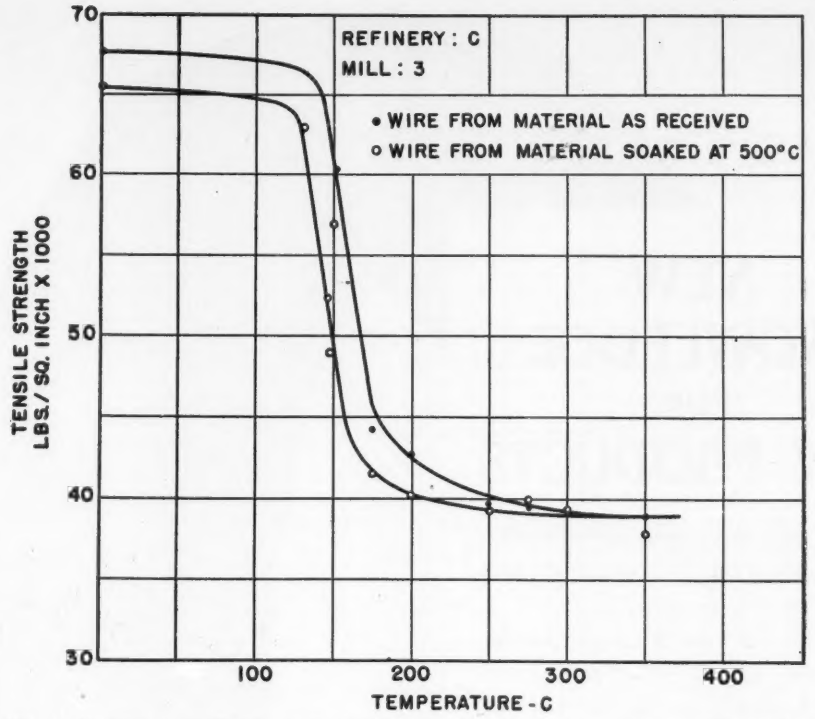

Fig. 5. Difference in annealing response between wire in as received and soak annealed condition. Wire drawn on factory equipment from 0.072" diameter to 0.0159" diameter, annealing time 15 minutes in salt bath.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

THESE tests might be criticized for the omission of any chemical analysis. However, it is believed that present day operations are so well controlled in refineries that copper with an off-composition would not reach the customer. Furthermore, the amounts of each single impurity in tough pitch copper are so small that any effect of the chemical composition on the annealing temperature would have to be studied as a combination effect not forgetting the possibility that many elements can exist in the oxide state or in solid solution. That the refineries do their part constantly improving the purity of the copper can be seen in Table II which shows a twenty year progress.

✦ ✦ ✦

THE result of the investigation of the annealing behavior of tough pitch copper rod can be summarized in a few words.

✦ ✦ ✦

One — The annealing behavior of a tough pitch copper is not only dependent on its chemistry, that is the presence and amounts of impurities, but also on the thermal treatment the copper is subjected to during hot rolling.

Two — If the copper is exposed to a rapid chill from a high temperature, which permitted certain impurities to form a solid solution with the copper, it is possible to lower the annealing temperature by an anneal at 500° to 600° C.

Three — Generally speaking good practices employed in the production of the hot rolled rod will materially assist the magnet wire manufacturer to make a sliver free and soft wire.

Four — A statistical approach is helpful in analyzing a problem encountered with a commercial material whose condition of production cannot be known to an investigator.

Acknowledgement: This investigation would not have been possible without the helpful support of Mr. H. A. Smith, engineer, Wire and Insulation Division, Fort Wayne, and Mr. R. S. Jenkins of the Fort Wayne Works Laboratory who made the necessary tests.

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Engineering Dept., L. A. Young Spring Co., Detroit, Mich.

A paper presented at the Wire Association Convention, Chicago, October, 1945. ✦ ✦ ✦

IN any manufacturing operation requiring the permanent deformation of material of any nature, the manufacturer becomes involved with one of the physical characteristics of the material which, though of the greatest importance in predicting the size and shape of the finished part, has had less time expended in investigating its behavior and control than any other of the physical properties. It is defined as yield point, proportional limit or elastic limit and its value together with its relation to the tensile strength of the material determine the forming properties of that material.

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THE yield point of hard drawn wire regardless of analysis is difficult to determine as the material is not a true elastic body and the stress strain line is a curve with a gradually decreasing radius and not a straight line. In order to establish some more or less fixed point for comparison of the different wires tested the value used as a yield point in the following charts is the load in pounds per square inch carried by the test specimen when the slope of the stress-strain curve is 1½ times it's original slope. The original slope was determined by taking an average of the slopes of short sections of the lower 1/3 of the stress strain curve. Where the lower section of the curve is a straight line or nearly so the method is the same as Johnsons and with a curved lower section the result is practically the same.

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DURING past several years we have been keeping records of the physical properties of hard drawn wire, both X1055 and music wire, that did not behave as expected when formed or coiled, in an attempt to determine the ideal physicals resulting in a uniform product with the expenditure of the least amount of labor, tool adjustment and inspection.

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THE results of these tests indicate that cold drawn wire with a yield point equal to between 55 to 75% of its tensile could be formed or coiled into springs or other parts uniform as to shape and size. Wire with higher yield strengths equal to from 80 to 90% of their tensiles resulted in non-uniform products or required frequent adjustment of the forming tools in order to maintain passable uniformity of the product.

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THIS is a reasonable result to be expected from material with a relatively large spread between yield and tensile as in forming any part from metal the force required must of course be sufficient to create a stress in the metal higher than its normal yield strength and less than it's tensile strength. When the particular piece of metal is one that has been processed to create a large spread between the yield and tensile strengths the yield point for some reason yet undefined is more uniform and consequently the form produced by a fixed amount of distortion is uniform. In forming multiple bends in a single die or any part with large radii a low yield characteristic is most advantageous as a high yield strength requires dies designed to produce a large amount of overbending to allow for recoil and any variation in yield will produce a proportional variation in the finished part. Assuming that the material being formed has a low yield point and the overbending required to form a given angle or radius is 10 degrees, a ten per cent variation in yield would change the finished angle one degree while with a high yield point requiring 15 degrees overbend in a die designed for only 10 degrees the variation in the finished angle would be approximately 6½ degrees. Even though the die were designed for high yield wire where the yield strength was 190,000 psi. a 10 per cent variation would cause a proportionately greater change in the finished part than when wire with a yield strength of 140,000 psi. were used and a 10 per cent variation encountered. The form shown here was produced in a punch press on a die that was designed for wire having a yield strength of 115,000 psi. The upper form resulted when wire with a yield strength of 133,500 psi. was used and the lower form from wire with a yield of 100,500 psi. Both wires were from the same lot of #8 hard drawn X1055.

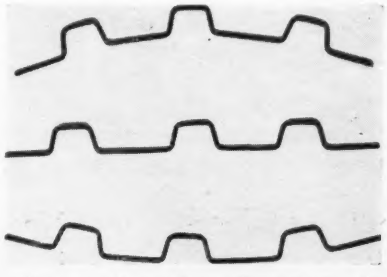

Fig. 1. ✦ ✦ ✦ ✦ ✦

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IN coiling springs from hard drawn wire variations in yield point are reflected in the spring as variations in free length, outside diameter and number of coils. These dimensions in a spring coiled on a standard type automatic coiler are interrelated as

the coilers are designed to feed a constant length of wire into each spring and if the yield point of the wire being coiled is higher than that for which the coiler was originally adjusted the coil diameter will be oversize and the spring length and number of coils decreased. The same conditions will of course apply in reverse when the yield strength decreases. On one small lot of compression springs having 4 coils and a coil diameter of 5/8" the free length varied from .525 inches to .6 inches. The wire used was .045 diameter music and a sample of wire taken from the bundle near a long spring had a yield point of 226,000 psi. while a sample adjacent to a short spring had a yield point of 239,000 psi. The tensile on both wire samples was 302,000 psi. The yield point of the actual lengths of wire used to make up the springs may or may not have varied to the extent indicated by the wire samples tested and the results cannot be taken as a basis for quantitative values. Physical tests on wire samples that have been coiled into springs and then uncoiled for testing always show a much lower yield and tensile than the same wire taken from the bundle so there is no procedure of testing that will fix exactly the amount of variation produced in the spring dimensions for a given variation in wire yield point. The effect of yield point variation decreases on springs with a relatively large pitch and a coil diameter less than six to eight times the wire diameter. In forming this type of spring the wire is stressed in both bending and torsion considerably above the true yield point of the wire plus the increase in yield due to the cold work of forming. The recoil of wire worked in this stress range is also less and all of these factors contribute to the uniformity of the finished spring. With a large coil diameter and small pitch the bending stress applied to form the pitch are only slightly higher than the yield stress applied to the wire to form the coil and the twisting stress applied to form the pitch are only slightly higher than the yield stress of the wire so that small changes in yield point amplified by the accompanying changes in recoil resulted in major changes in spring dimensions.

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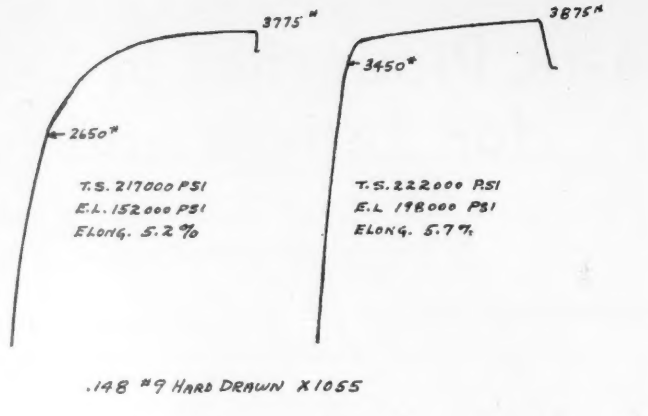

Figure 2. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

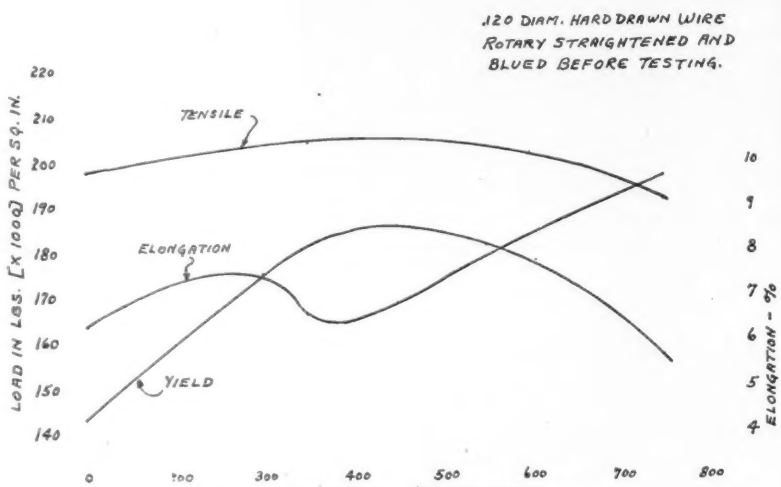

Figure 3. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

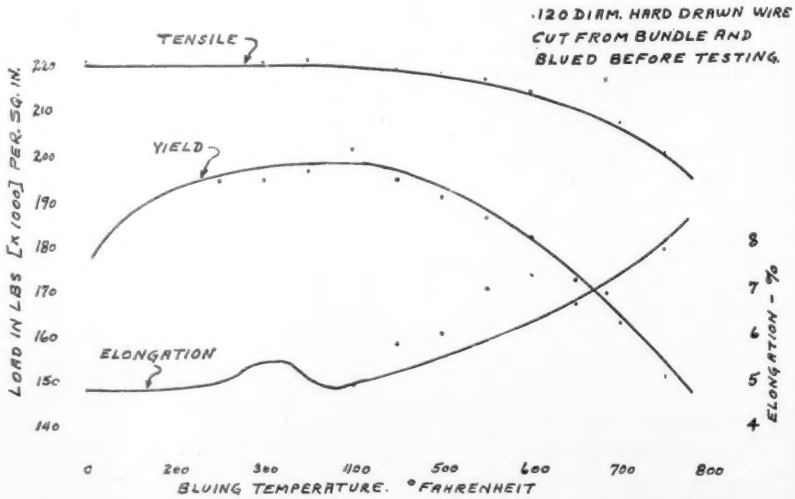

Figure 4. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

SAMPLES of #9 hard drawn X1055 wire taken from a bundle which produced uniform springs and from a second bundle which produced springs whose dimensions could not be held within acceptable limits were tensile tested and the results plotted on the following chart. (2)

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THE curve on the left of this chart is typical of hard drawn wire showing an indefinite yield point of about 70% of the tensile and represents wire that coiled and formed with very little variation in the shape and size of the finished part. The curve on the right was made by a sample from the same lot of wire as the curve on the left and springs made from this particular bundle varied in diameter and length as the physicals in the wire changed between the limits represented by the two curves.

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THE curve on the right is very similar to that produced by oil tempered wire or blued hard drawn wire and represents wire that could be coiled into very satisfactory springs if the physicals remained constant. It is out of place, however, in the company in which it was found as the definite high yield cannot be maintained by normal hard drawn wire practice and when found is a certain indication of trouble.

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IN checking over the curves produced by tensile testing hard drawn wire that can be formed with uniformity and little recoil and blued to a fairly high yield and tensile it seems very probable that the wire has no yield point as a whole and the knee formed in the stress strain curve is the point where all of the fibers in the wire, which originally were in various stages of compression, tension and neutrality have gradually picked up a tensile load and passed their elastic limit. Rotary straightening wild or erratic forming hard drawn wire will increase the uniformity of its physical properties to a point where the wire is suitable for production. The rotary straightening operation lowers and broadens the yield point of the wild wire and increases the spread between yield and tensile.

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THE following chart shows the physical properties of an unsatisfactory coil of wire tested as received and after bluing at different temperatures. A curve representing the elongation of the wire samples as received and blued at different temperatures is included to show the normal blue brittle range and a second drop in elongation at the point of highest tensile and yield. The second chart was made in the same manner and from the same wire except the wire was rotary straightened before testing. This operation lowered the tensile of the wire slightly and produced a very much larger drop in yield. The wire was easily worked after straightening and recovered sufficiently in strength after bluing to make it suitable for use in medium stressed springs.

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BECAUSE of these characteristics it would seem possible to produce cold drawn wire with a uniform low yield point of from 60 to 70% of the tensile psi or with no definite yield point in the as received state. Wire

(Please turn to page 884)

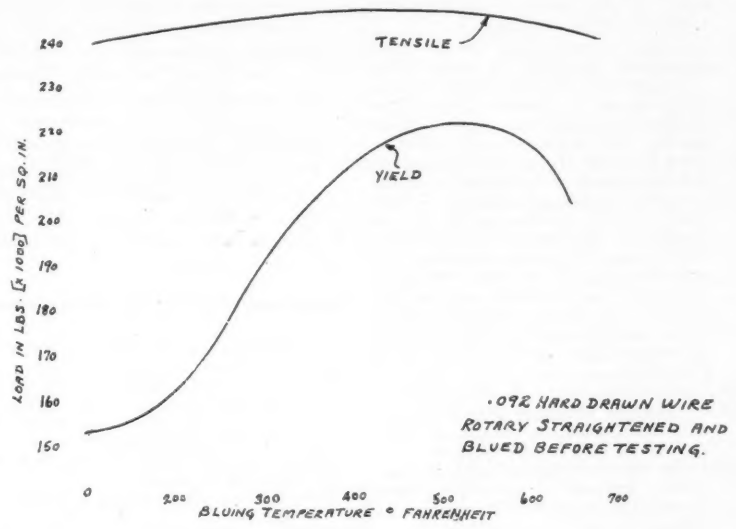

Figure 5.

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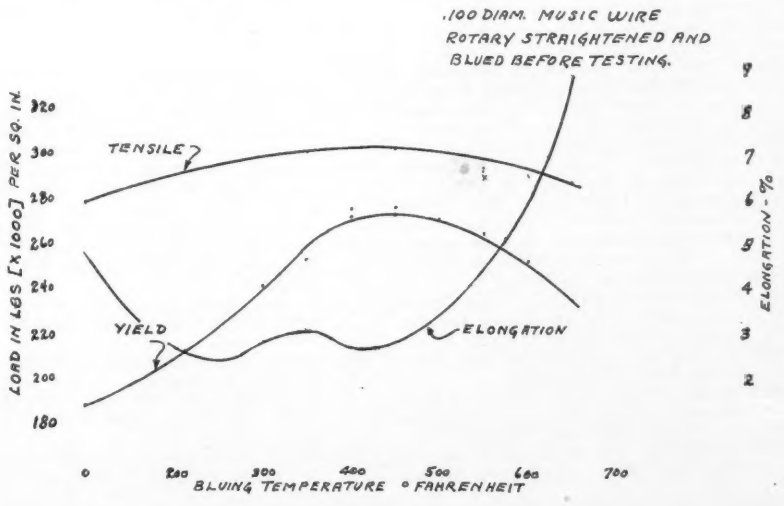

Figure 6.

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A Chronology of Wire and Wire Products

Compiled by F. R. Morral,

Metallurgist, American Cyanamid Co., Stamford, Connecticut

The chronology of wire revised and presented here represents research work which delved into French, German and English magazines and publications as well as American sources. The author states that he made a complete search of all books on patents and inventions he could find as well as all magazines published in several different languages and presents his conclusions herewith. Readers are invited to send in additional or missing data in order to develop as complete a history of wire production as may be possible. The original chronology, published in Wire and Wire Products August 1943, and this revision includes much additional material.

B. C.

8000 Copper found by early man.

5000 or earlier, perhaps, starts the history of wire making (drawing).

4600 Specimens of wire believed to belong to this period found by Petri in 1901 A.D.

4700-3800 Bronze made by deliberately alloying copper and tin.

4000 Egyptians acquainted with iron. Egyptians believed to pass their wire through holes in wood or possibly gems to remove burs from hammering and to render them smooth and uniform in diameter.

3745 Crown made of wire belonging to Queen Shubab of Samaria (in southern Mesopotamia) assigned to this time (Sir C. L. Wooley in Ur of Chaldees). A stranded gold hollow wire about 3/32 o.d., diameter of wire between 0.010 and .012 inch. This wire so braided and flexible that it flowed over a pencil like a snake when picked up with the ends of unequal length (Courtesy G. D. Hartley).

3500 Copper wire made by Egyptians.

3000 Gilding and bronzing done by means of finely powdered metal in suspension in a suitable vehicle.

2900 Long pieces of wire found at Saggarah, believed to have been made by welding together various forged pieces.

2750 A necklace belonging to an Egyptian Pharaoh of this time found at Denbarab. The necklace consisted of oval gold plates connected by a "crude chain of gold wires."

2500 Shu King — earliest mention known of copper in literature.

2200 Reference to wire made in China.

2000 Reference found to wire in India.

1700 Wire is used in Assyria and Babylon. Archeological evidence is good that in these times wire was made by shearing the wire from plates.

1544 Thirty-six pound garment of woven metal fabric found in tomb of wife of Emperor Honorius of Rome.

1491 Exodus XXIX-3, in the Old Testament was written: "beat the gold into thin plates and cut into wires" . . . for sacerdotal robes of Aaron.

1400 Greeks start to use iron.

1055 I Chronicles XXII-3 . . . "and David prepared iron in abundance for the nails, for the door of the gates . . ."

1000 Bronze wire believed of this time found in Scotland (1879).

850 Homer refers to the making of wire for net to catch Ares and Aphrodite by Vulcan (Odyssey, VIII p 273-8). According to Schliemann drawn wire may have been known at this time.

800 Bronze wire rope of this period unearthed at Niniveh (a sample of which is to be seen at the British Museum).

500 Wire rope believed to be made at this time buried at the destruction of Pompeii 600 years later. It is stranded according to Lang's lay.

406 Sophocles spoke of the tempering of iron in water.

400 Chinese claim to have known wire rope.

322 Aristotle wrote of the "bleaching of copper," forerunner of "dry galvanizing."

300 Fire or amalgam gilding known. Applied with silver as well as with gold, usually on brass or copper. Theophrastus appears to have written at least one book on metallurgy (no copy is in existence).

A. D.

77 Natural History by Pliny the Elder published. He mentions wire and the tinning of cast iron utensils and indicates that this method of coating was known since an early date.

79 Pompeii destroyed. A bronze wire rope found in this city (See 500 B. C.). This sample seen at the Naples Museum was almost 15 feet long with a 0.314 inch diameter and consisting of three strands twisted together.
At the buried city of Herculaneum metal heads with metallic hairs have been found.

200 Aelius Lampridius says of Emperor Severus Alexander ". . . and as for inserting gold threads (into his good linen) he deemed it madness . . ."

300-400 A crude rough wire die found in France, believed to belong to this date.

400 Coach screw found, diameter ½ inch, 4 inches long, at Silchester.

447 Wood screw found at Roman camp near Dalheim sacked on this date.

660 Wire filigree cross made by St. Eloy (to be seen in an abbey in Paris).

700 Nail industry started in Belgium.

700-800 Vikings in Norway used wire dies at this time according to archeological finds.

6th to 10th century it is believed that Venetiansa nd Italians have known of the method of wire drawing through holes in drawplates.

1003 One finds a historical note on the setup of an Osemund hammer (brought over from Sweden) on the continent to work iron.

1100 (?) Theophilus, a German monk, the first writer to refer to and describe draw plates. A foot of wire was drawn at a time. He also mentions and describes case hardening (translation by Robert Hendrie, 1847).

1260 Cold drawn wire as we understand it was being made.

1270 Wire drawing commercially applied in France.

1280 Albertus Magnus first to mention metal zinc by name.

1300 The importance of fracture recognized. Eminad-Din, author of the 13th century wrote . . . "When you look at a sword . . . look at it both inside and out."

1351 Rudolph of Nuremberg applies water wheels to wire drawing. Some authors attribute the first use of draw plates to him. Records of this time start to use the word "drawer," before it was mostly "wire smith."

1370 Hammering of wire still used in Nuremberg. The making of needles of bronze was an important branch of the industry in this city.

1435 Sept. 14, town record of Coventry, England: and then he goeth to his card wire drawer, and saith . . . and the complaint: "Sir, I had of you late, bad wire; Sir amend your hand, or in faith, I will no more buy of you."

1443 A book of this time mentions the making of wire for armored shirts.

1447-1450 A wire flattening mill was operating in Breslau.

1450 Christopher Columbus enters apprenticeship to be wool carder. There is indirect evidence that wire drawing was pushed along into finer sizes expressly for the production of card wire.

1456 Johan von Clever obtains privilege of wire drawing for Altena. Other important wire producing centers in the Germany of this period were Iselohn and Ludenscheid.

1460 There is a considerable wire industry at Coventry, England.

1465 England prohibits the import of wire. The restriction was soon removed because of the inferiority of the home product.

1486 Leonardo da Vinci designed a rolling mill.

1490 Conrad Celtes writes, "Urbis Norimbergae Descriptio." He wrote about Rudolph (See 1351 A.D.) who had kept his process secret.

1500 France ascribed wire drawing to Richard Archal.
Eobanus Hessus described in detail Rudolph of Nuremberg's wire mill. Production of fine wire accomplished by using of "rolls off and on."

1506 Wire mill set up in Zwickau.

1509 Ebener separated zinc as a metal.

1532 Eobanus Hessus describes the making of wires on pull benches.

1540 Used beeswax on gold wire for color and possibly for lubrication.

1540 "Pyrotechnica" of Vanuccio Biringuggio has a sketch of an Italian wire mill in book IX, chapter 8. He also writes about the technique to draw gold into wire, as well as silver, iron, copper and brass.

1546 Agricola in his "De Natura Fossilium" (book IX) mentions that the tinning of articles is well known.

1556 Georgius Agricola's "De Re Metallica published in Basel Agricola describes what resembles a modern screw.

1564 Very elaborate drawbench from this time is on exhibition in the Musee de Cluny, Paris, France.

1565 In England wire was handdrawn only up to this date. Patents granted to certain Germans or Dutchmen (Christopher Schultz and Caleb Bell) allowing them to set up a wire mill.

1570 Tournier took work on silver and gold to Germany, where Hackhel in Allesberg made it flourish.

1575 Tintern Abbey wire works in Mommouthshire started by four German families.

1588 Ramelli illustrates wood screw made by hand forging and rolling

1590 English railmakers (Godefroi de Bochs at Dartford) develop the slitting mill. Flattened bars of iron slit into strips were called nail rods.

1600 Johann Gerdes of Altena, Germany, discovered how to draw steel, although other kinds of wire had been drawn before.

1606 Patents granted in England to Sir D. Bulmer and C. Dawbeny, respectively, for cutting iron into nail rods by water power.

1617 Sir David Bulmer invented a machine for cutting nail rods. At this time many women and girls forged nails in England.

1620 Iron works at Falling Creek, in Jamestown River, Virginia, operating.

1624 Wire drawing introduced in Sweden by the Walloons of Flanders.

1626 Pin industry established in England. John Tilsby set up a plant at Stroud.

1629 Brama's metal rolling machine developed.

1630 Charles I of England again forbids the import of wire.

1643 First iron works established in what is no wthe U. S. at Lynn, Mass. English pinmakers were incorporated, paying 500 pounds for the privilege, which Charles I assigned to the privy purse of his wife, thereby originating the expression "pin money."

1644 Wire cable was used to hold masses of earth in the construction of Danzig.

1649 Copper and brass wire manufactured at Esher, England.

1650 First wire made in the United States.
At Altena, Germany, a wire drawer discovered by accident the possibilities of drawing high carbon steel wire by giving it a "sull coat."

1663 First mechanical wire mill in England set up at Sheen, near Richmond, Surrey, by Dutchmen.

1666 Nathaniel Robinson, a "wyer drawer," of Lynn, Mass., petitioned the Court for aid in carrying on his trade. He also made pins from native copper.

1667 Joseph Jenks rolled charcoal iron into plates. The plates were sheared into square rods to form the raw material for wire drawing.

1669 Brand (Germany) discovers phosphorus.

1670 Tintern Abbey Wire Mill, England, founded.

1676 Robert Hooke established that stress and strain are proportional within the elastic limit.

1678 John Ray describes the Tintern Abbey wire mill of his day.

1704 De Baufre & Fatio obtained a British patent for watch bearings i.e., drilling sapphire stones.

1710 First nail rod slitting mill erected in the United States in Milton, Mass.

1720 Penn's Wire Mill founded in England, near Sutton, by John Webster. At the present the same concern operates as Latch & Batchelor, Hays Mill, Birmingham, England.

1721 Samuel Bissel receives 200 pounds to encourage nail manufacture in Rhode Island.

1724 Von Lesjugo published a book containing a lot of information on the drawing of coarse and fine wires.

1726 Eckerman (Sweden) invented flat wire, which he used in clothes.

1728 Fleuer was rolling rods in grooved rolls. Fleuer, a French iron master, prepared a schematic production layout of his idea of a wire mill complete with time studies and calculations. In his plant he pushed up production ten times the best previous figure.

1730 and up, all wire cleaning in the works was by hand operation.

1731 A nail factory is built in Massachusetts.

1734 Swedenborg (Sweden) wrote first and oldest handbook of iron metallurgy "De Ferro," He visited plants in various European countries.

1735 Colombium discovered by Brandt (Sweden).

1740 Huntsman (England) invented the cruicible melting process for steel.

1741 Kenkel discovered zinc. Wood in England isolates platinum.

1742 Von Schwab first produced metal zinc by distillation of calamine.

1744 Von Lesjudo, Luebeck, publishes "Bericht von Gold und Silber drahtziehen." (On wire drawing gold and silver).

1745 Fleuer had a complete wire mill in successful operation in France.

1746 Marcgraf of Germany is considered the discoverer of zinc.
Dr. Roebuck of Birmingham, England, built the first lead chamber for the manufacture of sulfuric acid.

1750 Sir William Watson first described platinum (England). At this time a greasy rag was placed near the wire die. Wire reaching gage 7 had had 20 to 25 drafts and 3 anneals. The loss was usually 25 per cent according to reports from one plant. In this year zinc is used for hot dipping. England attempts to make wire for musical purposes from steel. It was found that beer gave iron wire a sull coat. Rinman (Sweden) suggested soaking steel wire in lime water. He also reported that pyroligneous acid would remove scale but only after immersion for one or two months.

1751 A. F. Cronstedt first isolated nickel.

1754 Henry Cort (England) built the first iron rolling mill.

1760 Revolving wire drawing block possibly applied to coarse wire. Job and William Wyatt of Burton on Trent were granted a patent for the production of screw machines by machine. Wire nails made in France by hand with a hammer.

1761 Rene Antoine Ferchault de Reaumur published book on "L'Art de l'epinglier" (needle manufacture). He is considered to be the first to have actually systematized metallurgy.
C. Pohlem (Sweden) inventor of various machines and apparatus used in the metal and other industries wrote his "Patriotic Testament" giving details of his inventions. Among others he designed a shear to cut nails.

1764 Gallon writes a treatise on methods of producing wire.

1766 John Purnell invented machine for making ship bolts, large round rods of iron and steel, and iron and steel wire of various sizes by rolling.
Pianos first made in England.

1769 A rod mill consisting of several pairs of rolls coupled together patented by a Mr. Ford (England).
Henri Louis Duhamel du Monceau publishes "L'art de reduir le fil en fer" (The art of iron wire manufacture).

1770 A rolling mill and slitting mill built at Boonton, Morris county, N. J., by a member of the Ogden family.

1772 Sven Rinman publishes his "Anledning till stal och Jernsforald-lingen och des forbettring" (Introduction to the metallurgy of iron and steel) with a chapter on wire drawing. Amongst other he recommends to dip the wire before annealing in a mixture of 2 parts of lime and 1 part of clay, which is thinned out with water. He also described a wire mill of his time.
Wire rope invented by Berghauptmann (mining engineer) von Reden.

1773 Sven Rinman (Sweden) reduced manganese to the metallic state.

1774 Gahn (Sweden) isolates manganese.
Scheele in this year in a paper describes his discovery of manganese (Sweden).
A. G. Werner suggests first hardness scale, with diamond hardness as the highest step.

1775 Nathaniel Niles of Norwich, Conn., establishes a wire factory. This was apparently the start for the commercial importance of the wire industry in the United States.

1777 Jeremiah Wilkinson, of Cumberland, R. I. made the first cold cut nail in the world, according to a Rhode Island historian.
Johann Henrich Jung, sometimes called Stilling, writes of the industry as practised in Altena, West-

phalia. He described wire mills and shops making pins and needles.

1780 Hjelm (Sweden) discovered molybdenum.
Frenchman Reignier invented an arrangement which permitted to make wire rope.

1783 d'Elhuyar brothers (Spain) first obtained tungsten in the metallic state.
Henry Cort took out his first patent in England on the use of grooved rolls.
Discovery of the puddling process made it possible to make material similar to the Osemund, but much cheaper.

1786 Guyton de Morveau (France) isolated and defined two types of carbon in steel: iron carbide and graphite.
E. Reed, of Bridgewater, Mass., patented cut nails made by machinery.

1787 J. G. Pierson patents nail cutting machine. At this time he made nails in New York City.

1788 A large wire mill was operating in Dedham, Mass., making wire for cards in the textile industry and for fishhooks.

1789 Klaproth (Germany) isolates zirconium.

1790 America's first nail factory was erected in what is now Phoenixville, Chester county, Pennsylvania, and known as the "French Creek works."
Jacob Perkins of Newburyport, Mass., invented a nail cutting machine (200,000 nails per day) (Patent 1795).
J. Clifford made a machine for forming nails.

1791 Gregori (England) isolates titanium.
Pittsburgh. Wire imported from abroad is reduced in size.

1792 I. Canfield and J. Losey of Dover, N. J. establish there a rolling and slitting mill. They also added a factory for cutting nails. The nails were headed by hand in dies.
The first authentic report that diamond has been drilled is found in the book of F. A. A. Eversmann, "Technologische Bemerkingen auf einer Reise durch Holland") "Technical observations on a trip thru Holland). A Dutchman by the name of Andreas Bevelman is said to have invented this art.

1795 Jacob Bowman built first nail mill west of the Alleghanies at Brownsville, Pennsylvania.

1796 Samuel Gypsy got patent for rotating machine to cut nails and head them.

1797 Harris of Waltham Abbey, Essex, is granted a patent to make needles by machine.

1798 Vauquelin (France) isolates chromium and beryllium.
David Wilkinson of Pawtucket, R. I., invented a machine to make screws in metal with a form of slide lathe.

1800 Light scale on annealed wire removed by boiling the wire in tartar. Wire to gage 20 has 40 drafts and 6 anneals in one of the mills of this time described by a visitor.
Last ten years 1790-1800) has seen 23 patents taken out in the United States on nail cutting machines.
Henry Mandslay brought about a uniform thread which went far toward making screws of the same size interchangeable.
In wire manufacture, wire drawers blocks, rod rolling and pot annealing known and used in England.
-to 1830 in Southern and Eastern Europe used dies made of material harder than chilled iron.

1801 Del Rio (Mexico) discovered vanadium.
Hatchett of England discovers colombium.

1802 Ekeberg of Sweden discovers tantalum.
Congress learned that New Jersey possessed four rolling mills and slitting mills "which rolled an average of 200 tons, one-half of which were manufactured into nails.
Buschaendorf of Leipzig (Germany) recommends use of sal ammoniac instead of resin, as a flux in galvanizing and tinning.
Joseph Bramah of London applied the hydrostatic press to cranes for hoisting merchandise and afterwards to tools in his own workshop.

1806 Substitution of vitriol for barley meal as a medium for pickling purposes of thin sheets.

1808 Davy of England is the discoverer of magnesium.

1810 Memoir of Messres Monchel on French wire drawing in the Repertory of Arts (for abstract see The Wire Industry vol. 5 p. 745). This concern used protective atmosphere in furnaces. A list of prices of their wire is also given.

1811 A loan was granted to William Eichbaum of Pittsburgh by the Pennsylvania legislature. It enabled him to complete and operate a wire mill.

1813 Dr. W. H. Wollaston first succeeded in drawing platinum wire 1/30,000 inch in diameter.
Clemens Rentgen built a plant to roll round iron in Chester, Pa. He was granted a U. S. patent in 1810.

1815 Rod rolling done by William Bell in England.

1816 White and Hazard of Philadelphia first made wire fence.
First wire suspension bridge in the U. S. thrown across the Schuylkill River near Schuylkill Falls in Philadelphia.

1817 Daniell Treadwell and Phineas Dow of Boston patented improvement to their wood screw machine.
Colbert, a German clockmaker introduced drawn wire instead of forged rods for screw blanks.

1818 Rod rolling done by Thomas Todd and W. Church in the U. S.

1819 Brockedon patented use for fine wire draw plates of the hardest precious stones drilled with orificies of the sizes required.

1820 Dr. John W. Revere of New York presumably electrogalvanized wire using voltaic batteries (the New American Cyclopedia, vol. 5, p. 65).
By chance it was found that a thin copper coating facilitated the drawing of wire (England).
Moh's scale for hardness proposed. Diamond-10.
Prof. Morse in his experiments in telegraphy had his coils covered by the Alfred F. Moor Co. of Philadelphia. This concern was in the manufacture of covered wire for framing ladies bonnets.
Coulomb, French physicist experimented with the torsion balance. A piece of wire when twisted, resisted the twisting force or torque in direct proportion to the fourth power of the wire diameter.

1821 U. S. produced 250 tons of wire per year.
Wire rope manufactured in Germany.
J. Thorp of Providence was granted a patent for braiding wire.

1822 Geneva, Switzerland. Wire rope was used in the construction of the suspension bridge. It was of the selvagee type, namely it consisted of parallel wire bound together by exterior wires.
Albrecht used wire ropes for winding in shaft of mines at Claustahl, Prussia.
Stoddard and Faraday showed that ordinary metals dissolve faster in acid when galvanic couples are present.

1823 Berzelius (Sweden), isolates silicon.

1824 L. W. Wright, Mass., invented a machine by which a perfect pin was produced during the revolution of a single wheel. It was the first satisfactory automatic solid headed pin-making machine.
Webster's discovery of steel refining by chemical fluxes lead to the displacement of continental wire for piano strings in England.

1825 Oersted (Denmark) discovers aluminum.
The U. S. has granted 120 patents on nail manufacture.

1826 Charles Barnard of Norwich, Conn., started the wire netting industry.

1828 Karsten developed what is now known as the "rod mill," a three high mill.
Fine wire, size not specified, was getting 35-40 passes and 4 to 5 annealing treatments.

1830 Sefsstrom of Sweden described vanadium.
Ichabod Washburn built first three high rolling mill at Fall River. He experimented from 1821 to 1830. A treatise dealing only with wire drawing published that the production of coarse wire per man was 50 pounds per day.

1831 The Rev. Dionysius Larchier writes on the, "The progressive improvements and present state of the manufacture of metals."
J. A. Roebling, 25 years old, came to America.

1832 A committee of the Franklin Institute designed and built a tensile testing machine.
Wilson, an Englishman, claims to have constructed the first helicoidal rope.

1834 Three wire mills in the U. S. Total output 15 tons per year.
W. A. J. Albert, mining engineer, produced a helicoidal rope which was used at the mine of Carolina, near Claustahl.
Roebling used cable in the construction of the Niagara bridge.
Fine wire woven into sieve cloth by B. Gilbert of Georgetown, Conn.

1836 Sorel (France) patented hot dip galvanizing.
A Smith and J. Lionel Hood obtain a letters patent for use of metal wires for making rope.
Before this date screws were little known and made by hand. American invention of that time made them semi-automatically.

1837 M. Sorel of France was granted U. S. patent 510 on method of preventing iron and steel from rust and oxidation (hot dip galvanizing.)

1838 Sept. 28. The minister of Marine of France gave instructions to test

the method of protecting iron by hot galvanizing. The tests lasted until May 14, 1840. The report recommended to have wire exposed to gases coated, as well as nails. Soon afterwards hot galvanizing of steel wire became important.
Niles Berry obtains a patent on galvanizing by cementation. This method was unsuccessful because he failed to use blue zinc powder.

1839 Rod mill built at Fall River, Mass. The first important improvements in American practice of producing wire rod were incorporated. Twenty-five pound billets were used. This mill burned down and was rebuilt in 1843 with more improvements. It is said that the capacity was doubled.

1840 Roebling makes first wire rope in the U. S.
Electrodeposition of silver from cyanide solution found by Dr. John Wright, M.D.
Mr. Newall of Dundee took out a patent for the first wire rope making machine. A friend who was studying mining in Saxony wrote to him in June, 1938, making a suggestion. The machine made four strands of 4 wires each.

1841 First patent issued on cadmium plating in England.
Sir Joseph Whitworth, pupil of Mandslay urged uniform system of all screw manufacture. His standards accepted after some years in England, to lesser extent in the U. S.

1842 Cullen Whipple patented a machine that would make a screw with a "gimlet end."
G. Elkingston established at Birmingham (England) the first plant for practical electroplating.
Cobalt successfully electroplated 1842-45).
Large part of the Morse telegraph wire first laid between Washington and Baltimore was rolled on the continuous mill invented by J. E. Serrell (U. S.). First recorded patent and originally planned for rolling lead and copper pipe.

1843 G. Ekman (Sweden) invented a continuous heating furnace for heating long rods or billets.

1844 Wire netting up to present time done by laborious process. At this time it actually became an industry and is associated with C. Barnard of Norwich, Conn.
Roebling builds a suspension bridge using parallel iron cables. The Pittsburgh Aquaduct.

1846 Thomas J. Harwey patented a partly automatic screw machine.
Beckman publishes his "History of Invention."
Morewood and Rogers patented equipment to control uniformity and thickness of hot galvanized coating on wire.

1847 The demand for telegraph wire began (Stubbs gage No. 9) sometimes painted or boiled in oil to prevent rusting.
Cornelius van Houten made first loom in the U. S. for weaving Fourdrinier wires (Belleville, N. J.) He made it after a model brought from England.

1848 Max Pettershofer proposes the copper sulfate test for galvanized telegraph wire. Later it became known as the "Preece test."

1850 Water was found satisfactory to sull iron and steel wire.
Jonas Chickering the Father of American piano forte makers finally obtained music wire with the purity of tone required.

1851 W. Hassal made first wire nails in the U. S. from iron or brass.
Thomas Morton in New York City built a wire nail machine. This machine operated for 52 years and is on exhibit at the American Steel and Wire Industrial Museum, Worcester, Mass.

1853 Sulfuric acid used for pickling rods in Belgium.

1854 Mr. Washburn's Quinsigamod wire mill bought 600 pounds of vitriol.
William Smith of Warrington (England) made for many years it is claimed successfully "patent cast steel wire."
Horsfall's patent consisted of revolutionary hardening of wire followed by tempering in molten lead. It was the origin of "patent and plough steel wire."
English patent to Charles Cleophas Person, an early record of electrogalvanizing.
Bunsen (Germany) reported the electrodeposition of chromium.

1855 Brown and Sharpe gage based on geometrical system proposed.
American Iron and Steel Institute founded in Philadelphia on March 6.
Wire cleaning with sulfuric acid started in the United States.

1856 Manufacture of poultry netting fabric started in Clinton, Mass.
Kelly in the U. S. (1850-56) and H. Bessemer in England invented the converter process of refining iron.

1857 I. Washburn, Worcester, Mass., developed and patented the continuous process of hardening and tempering music and crinolene wire.

1858 G. Bedson drew the wire for the Dover-Calais submarine cable; and 950 tons of wire of No. 22 best charcoal iron wire for half of the first Atlantic submarine cable.
The American Standard wire gage, originated by Brown and Sharpe was adopted by the Brass Manufacturer's Assn.
First transatlantic telegraph cable failed.

1859 Patent steel wire first used in colliery and steam plow ropes.

1860 Before little chemical cleaning was done. Afterwards supply of sulfuric acid became more plentiful.
Patent steel wire first used in submarine cables.
Bernard Lauth patented cold rolling process for wrought iron to produce cold drawn bars.
Find first references to drying and baking of wire. Apparently this was used generally after the introduction of Bessemer steel.
Walter White wrote "All around the Wrekin," where he describes his visit to the wire works of Messrs. Cornforth in Birmingham, (England). Wire was drawn at 150 feet per minute, and finer wires at 300-400 ft./min. The wire was annealed in wells 8 ft. deep, the coils closely packed and covered for 24 hours. Ordinary steel underwent 6 drawings and 6 annealings. The coils were pickled in dilute sulfuric acid, bathed in lime water and flour. The cleaning of the steel was done by shutting it up with gravel and water in a rotating vessel. The demand for crinolene was great.
The Bedson process for continuous hot dip galvanizing of wire described in Annales Telegraphique of Paris.
Cuck described a wire galvanizing plant.

1861 October 22. The line which permitted communication between the Atlantic and the Pacific opened. The first message transmitted was the news of the defeat of the Union Army at Ball's Bluff.
Reichenberger described a galvanizing unit in Bavaria in Dingl. Pol. J1, vol. 161 (1861) p. 194.
The Cambria Iron Co. was the first to employ a chemist at an iron works laboratory.

1862 C. Beslay of Paris, France obtained U. S. patent 36,750 on improved method of electroplating iron, steel, etc.—"cold galvanizing."
Siemens invented the Open hearth process.
G. Bedson, Manchester, England, patented his continuous rod rolling mill which produced 20 tons of No. 5 iron wire rods in 10 hours.
Washburn succeeds in adapting the wire drawing block to coarse wire drawing.

1863 H. C. Sorby first applied the microscope to the study of metals.
W. Hughes designs and builds a wire torsion testing machine. It was employed by Webster and Horsfall's wire mill.
Bessemer tries continuous casting of billets.

1865 The Martin Brothers in France developed the pig and scrap process in lieu of the pig and ore process of Siemens.
Patent steel wire first used and homogeneous metal (crucible melted cast steel, .042% C.) in second Atlantic cable. The contract to the firm of Webster and Horsfall of Hay Mills was for 1600 tons, 60/70 tons per square inch tensile strength, size 0.095" with a delivery of 40 tons per week. Price 45 pounds per ton.
Braiding machine for covering wire was invented starting the insulated wire industry.

1866 I. Washburn introduced the continuous process of annealing, cleaning and galvanizing in his plant in Worcester.
Bedson's wire galvanizing process used in Manchester described in Ann Telegraphique, p. 445.
First American open hearth erected in the U. S. in Trenton,N. J.
On Nov. 27, a petition was filed in Massachusetts to form a corporation "for making wire and wire rods, cotton yarn and foods, with a capital larger than at present allowed." The petitioners were asked to be incorporated under the title of Washburn and Moen Wire Works with a capital of $600,000.

1867 April 2nd. A. Dalb obtains U. S. letters patent 63,482 for pricked wrought iron strips.
June 25, L. B. Smith, July 23, W. D. Hunt, patents embodied the basic ideas in barbed wire construction.
J. A. Roebling starts building Brooklyn bridge, the largest suspension bridge to be built at the time, and not completed till 1883. At the Tintern Abbey Wire Mill in Wales the rods were partly pickled and partly tumbled. In 1863 Mr. Washburn had described his pickling procedure to Bedson, who replied that it was interesting but would never

be adopted in England because of high cost of sulfuric acid.

1868 February 11, Kelly obtains patent on barbed wire construction.
March 10, W. Towbridge, New Orleans, Louisiana, obtains a patent which developed into a practical wire bale tie.

1869 C. H. Morgan, Worcester, Mass., designed and used a power traction reel for wire rod. Shortly afterwards he developed a pouring automatic reel. With an assistant he also designed the "whirling pipe."
Wire bale tie industry established by Laughland and Lowber, N. Y.

1870 Started to use diamond dies in wire drawing.

1871 Washburn and Moen Mfg. Co., Worcester, Mass., first to substitute Bessemer and open heart steel for wrought iron for wire making.
Heinrich Westphal patented the idea of a spring mattress while recuperating on a hard hospital bed from wounds received in the Franco-Prussian War. He presented his first mattress to Prince Bismark. He died a pauper.

1873 C. D. Hunt of Fairhaven, Mass., took out patent U. S. 135,339 on improvement in metal coating tacks, nails, etc., process essentially still being used daily.
A. L. Holley in a paper presented to the A.I.M.M.E. advocated the use of chemical analysis as well as physical testing to determine the character of steel required for specific uses.

1874 Joseph F. Glidden secured two patents on barbed wire. His patent of Nov. 24, No. 157,124 was considered an epoch-making invention because of benefits to mankind. It has been publicly exhibited for many years in Washington, D. C.
J. F. Glidden and R. W. Vaughn devised machinery for rapid production of barbed wire.
J. F. Glidden, I. L. Ellwood and J. Haish began manufacture of barbed wire in small scale.
Up to this time in the U. S. only five patents on wire drawing granted. In this year 12 were granted.
Five tons of barbed wire produced in this year.
Bell transmits first complete sentence over copper wire.

1875 First wire nails in the U. S. with a machine imported from Germany by Father Goebel, Covington, Ky.
Morgan develops his continuous mill.
Roebling receives a patent on 6 strand rope; three strands were twisted in one direction and three in the other.

1876 Father Goebel establishes the American Wire and Screw Nail Co.

1877 W. McCallip of Columbus, O., improved the "repeater" doing away with manual help.

1878 Sir W. Siemens constructs the first electric furnace of any importance.
Three hundred patents granted for nail making machines in the U. S.
J. R. Ramsden developed an arrangement to harden and temper wire continuously.

1879 C. H. Morgan invents an automatic repeater.
Automatic reeling of wire rods used experimentally at the Washburn and Moen Works. Use only horizontal rolls in the continuous mills (Bedson's had half verticle).
Morgan develops process of oil tempering wire for springs.
John Lang patents a rope with all the strands and wires twisted in the same direction (known as Lang's lay).

1880 Hughes first called attention to hydrogen embrittlement of iron wire on pickling.
The manufacture of square umbrella wire commenced at Cleveland, O.
Lead encased cable started to be used.

1881 Asbestos wipes used in wire galvanizing invented.
H. Roberts annealed wire in iron pots in a muffle furnace.
The import duty on wire rods in the U. S. was reduced from 1.2 cents to 0.3 cents per pound. Practically every wire rod mill had to close down.
H. Chisholm developed the practice of making a 4-inch billet from an ingot without reheating. In one heat he made from the four inch billet a No. 5 wire rod.

1882 E. H. Hill obtains patent 264,535 on process and apparatus for coating barbed fence wire with metal.
H. Roberts invented the sloping floor of rod mills.
First Garrett rod milling mill erected. He also adopted the power reel, which permitted finishing two rods simultaneously.

1883 Osmond announces transformation points in iron and steel.
"Inhibitors" for pickling patented. Use to prevent acid brittleness.
The first steel cut nails made at Wheeling, W. Va.

1884 Woven wire fence first made by machinery by J. W. Page of Michigan.
John Hassal who had been a soldier in the Civil War designed an improved nail machine.
E. C. Batchelor received letters patent for the lock coil rope.
Imperial wire established by law in England.

1885 Dies for bar drawing perfected.
John Robertson invented lead encasing die block for cable.

1886 Moissan in France discovers carbides, and methods of making them in furnace.
Sorby described microstructure of steel.
600,000 kegs (100 pounds each) of nails produced in the U. S.
The Association of wire nail manufacturers prepared a standard wire nail card.

1887 Galvanized wire netting put on the U. S. market.

1888 Patent 395,269 was granted to O. Eberling on a mode of covering iron surfaces with lead.
Hall-Heroult electrolytic process makes possible commercial production of aluminum.
In the U. S. 44 factories operated for making barbed wire with 2190 machines. The requirement for wire was 150,000 tons. Production of wire nails exceeded that of cut nails for first time.
English patent on waste pickle liquor disposal granted.
Flattened strand rope patented by Latch and Batchelor.

1889 Eduard and Jos Louis Martin of Paris, France patented a copper clad iron wire which was drawn.
First cold drawn bar made in America.

1890 Heroult invented the electric arc furnace widely used today (1944).
J. B. Stone patented filler construction in ropes.

1891 C. R. Smith of Providence, R. I., according to patent 448,594, obtains a thin layer of another metal on a metallic rod, then he covers this with a metallic tube, fuses the two layers and reduces to wire afterward.
J. Bucknall Smith publishes in England his book, "Wire, Its Manufacture and Uses."
Carborundum discovered by E. G. Acheson.

1892 U. S. Barbed wire production 200,000 tons; 4,719,524 nail kegs.
James Midgley succeeded in patenting music wire.
J. M. Swank published his book on the "History and Manufacture of iron in all ages."
L. Beck publishes in Germany "Die Geschichte des Eisens" (History of Iron) in five volumes.
Begtrup's formula for ordinary helical compression springs published in the "American Machinist."

1893 J. D. Curtis granted patent 495,626 on electric welder for wire fence machines.

1895 The first staple tie fencing made by Lamb Bros. in Michigan.
Morgan introduces his gravity discharge continuous billet heating furnace.
W. Holland, Jr., patented a method to heat wire uniformly by electric heating.
U. P. Wood writes: ". . . to thoroughly clean the surface to be coated is found to be the principal difficulty in the application of any electrochemical process for zinc."

1896 Moissan discovers method of making tungsten carbide.
A. J. Bates invents American field fence making machine (Joliet, Ill.)

1897 Great wire consolidation, the American Steel and Wire Co. being formed with a capital of $70,000,000.

1899 Ch. C. Baldwin obtained a patent according to which automatically adjusted speed of take up block was possible.
W. L. Emmet of G. E. obtained a patent for first varnished cambric cable.

1900 Brinell invents his hardness tester.
Sir Sherard Cowper-Coles originated sherardizing, or zinc coating of bolts and nails, etc., by a diffusion process.
The first Anthony woven fence made at Tecumseh, Mich.
American Steel and Wire produced 35,393 tons of woven wire fencing.

1902 Wright Bros. fly at Kitty Hawk.
Wire and Wire Products enter aviation industry.

1905 American Steel and Wire produced 285.039 tons of woven wire fencing.
W. R. Wilbur publishes: "History of the Bolt and Nut Industry in America."

1907 Dr. Baekland first produced "Bakelite."
Shore scleroscope developed.

1908 Dr. W. D. Coolidge of the Research Laboratory of G. E. succeeds in drawing tungsten wire.

1909 Newall and Skelton patent a non-twist rope made up of elliptical strands.

1910 Lescher patented a rope with ellipti-

(*Please turn to page 885*)

Wire Association Convention Notes

Medal award for 1944 to A. R. Zapp—Details of Convention and Technical Meetings—Plans for 1946. ✦ ✦ ✦ ✦ ✦

PROBABLY the most successful and best Convention ever held by the Wire Association was the one at the La Salle Hotel, Chicago, Illinois, October 15-18 inclusive, 1945.

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WITH an attendance of slightly over 300, active discussions on all papers presented at the meetings and plenty of room discussions later, the whole atmosphere was one of interest and attention to business.

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AT the Directors Meeting held Monday, October 15th, preceding the opening of the technical sessions, the Medal Award for 1944 was made. This Annual Wire Association Medal is presented to the author who must be a member of the Wire Association who submits the paper regarded as **"the most meritorious paper on wire manufacture or fabrication prepared during the year."**

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THE selection is made by the Board of Directors of the Wire Association, who consider all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the calendar year.

✦ ✦ ✦

FOR 1944 the paper entitled "History and Growth of the Tungsten Carbide Die," by **A. R. Zapp, manager, Carbides Division, Firth Sterling Steel Co., McKeesport, Penna.,** was voted the outstanding and meritorious consideration of the year.

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IN reaching its decision the directors took into consideration two other papers on the same subject written by Mr. Zapp, the three papers forming a continuity on the subject of Carbide Dies, making a most important contribution to the industry as a whole.

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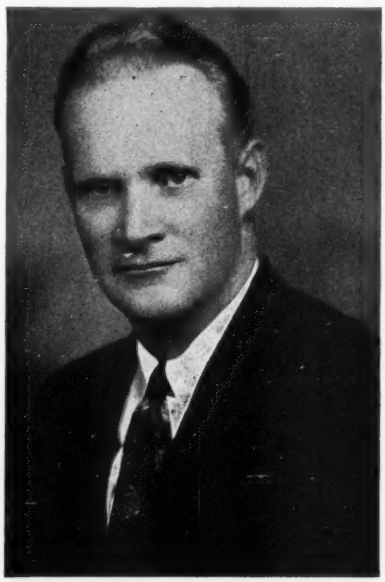
THE **Board of Directors** extend their congratulation and appreciation to Mr. Zapp for excellent research.



A. R. ZAPP
Medal Award — 1944

Attended Franklin & Marshall College, The United States Naval Engineering School, and Stevens Institute of Technology. Served two years as Engineering Officer in U. S. Navy. Five years in the Research Division of the Allied Chemical and Dye Corp. Four years with the Reily-Stoker Corp. Three years with Union Wire Die Corp. From 1932 with the Firth-Sterling Steel Company as manager of the Firthaloy Division. In 1945 appointed manager Carbide Division. ✦ ✦ ✦

HONORABLE mention went to **Mr. F. S. Stickney, Vice President and Chf. Engr., Instrument Specialties Co., Little Falls, New Jersey,** for his paper entitled "Making 'Spring-Grade' Beryllium Copper Wire."

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A VOTE of thanks was extended to **Mr. Kenneth B. Lewis,** Consulting Wire Mill Engineer, Chairman of the Ferrous Division of the Program Committee for 1945, and **Mr. Sidney Rolle,** Assistant Manager, Scomet Engineering Co., Chairman of the Non-Ferrous Division, for their splendid and detailed preparatory work in connection with the arrangements of the Convention Program.

✦ ✦ ✦

FOR the 1946 Program Committee, the President appointed Mr. John A. Moritz, Vice President in Charge of Operations, Mid-States Steel & Wire Co., Crawfordsville, Indiana, Mr. Leroy D. Seymour, Manufacturing Manager, Rope and Wire Fabrics Division, John A. Roebling's Sons Co., Roebling, New Jersey, and Mr. E. W. Gundstrom, Assistant Plant Manager, Rome Cable Corporation, Rome, New York.

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IN accordance with the custom of the Association to replace at least one-half of the existing Board each year with new men, the Nominating Committee for Directors have submitted the following names to be voted upon:

For re-election:
John C. Callaghan, Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada.
Richard E. Brown, Publisher, "WIRE & WIRE PRODUCTS," Stamford, Conn.
For Original election:
S. A. Braley, Chief Metallurgical Field

Engineer, Pittsburgh Steel Company, Pittsburgh, Penna.
H. B. Carnahan, Assistant Works Manager, Canada Wire & Cable Co., Ltd.
Fred M. Crapo, President, Indiana Steel & Wire Company, Muncie, Indiana.

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IN the event of these names being favorably voted upon by the membership who will receive a mail ballot shortly, the following directors will retire as of March 15, 1946:

W. H. Crawford, Resident Manager, Eaton Manufacturing Co., Reliance Spring Washer Div., Massillon, Ohio.
E. W. Gundstrom, Assistant Plant Manager, Rome Cable Corp., Rome, New York.
B. L. McCarthy, Director of Research, Wickwire Spencer Steel Co., Buffalo, New York.

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THE place of meeting for the 1946 Convention was discussed and by a process of elimination, the directors voted to hold the Convention in either Toronto, Canada, or Philadelphia, Penna., with Toronto being first choice, if satisfactory hotel arrangements could be made.

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FURTHER, in order to obtain a concensus of opinion from members, a letter is being sent requesting each member to indicate his preference and whether or not he would plan to be at the Convention in 1946, at either place mentioned.

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PRECEDING the technical sessions, the officers and directors of the Association invited the members of the Program Committee, the speakers, and the chairmen of the various sessions, to attend a luncheon for the purpose of becoming acquainted and laying plans for a successful carrying out of the program arranged.

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THE President of the Association, stated, in opening the luncheon:

"We wish to welcome the directors, program committee, and chairmen, also those who are contributing papers and discussions to the success of our Wire Association meetings. This get-together is primarily for getting acquainted with those who are participating in the entire program, and we want you to know the directors appreciate the fine spirit of cooperation in your contribution of papers and committee work, which has been so necessary in building up this program, as we realize it requires a vast amount of time and effort on the part of each individual to do a job of this kind. I wish to thank Mr. Ken Lewis and Mr. Sidney Rolle for the very excellent work that has been done in working out their program and papers."

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THE technical sessions opened promptly at 2:30 P.M. on Monday, October 15th, and in the President's opening address, Mr. Buchanan said:

"We are very happy we are again privileged to meet as a Wire Association and open this convention, which is the second that we have held as a Wire Association on our own. In previous years we met with the ASM but in 1944 it was necessary for us to separate from the ASM, as you know, due to the hotel situation. I must say that our Pittsburgh meeting last Fall was very gratifying and we felt there was more attention and interest by the Wire Association members with meetings of this type. From all indications of the registration and your attendance at this opening meeting, there is a close unity within the Wire Association membership. I could quote you figures which prove this point but that is unnecessary as you will see from the contacts you will make throughout the entire convention, and the interest that is shown in the papers presented.

I think our secretary should be complimented on the alertness that was shown in handling this whole situation throughout the year as at the Directors Meeting in March it was very doubtful if we would be able to hold a convention but our good secretary constantly had a feeling that somehow, some way, the Wire Association would not miss a convention this year. In July the clouds looked very black but Mr. Brown held off making application to ODT, and the first part of September came the first indication there would be a break in holding conventions, and Mr. Brown immediately jumped into the breech and through his foresight had everything prepared, either for a convention such as this, or one conducted by mail, and while there was a vast amount of work to be done you can see today that he came through with flying colors, just as our Army and Navy have done in this War."

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THE Annual Luncheon held on Wednesday, October 17th, was attended by 148 members and the guest speaker was **Mr. L. S. Hamaker,** Assistant General Manager of Sales, Republic Steel Corporation, Cleveland, Ohio, who presented a most informative and interesting picture of the outlook for the whole industry during the reconversion period.

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THE Annual Smoker-Dinner was held on the evening of October 17th, with the attendance of 360. It was unanimously voted to be the best show the Association ever had and a unanimous vote of thanks was tendered to Mr. A. R. Zapp, Manager, Carbides Division, Firth Sterling Steel Company, for his efforts as chairman and sole operator of the Smoker-Dinner Committee.

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The Technical Sessions Ferrous Division by our Special Correspondent

ALTHOUGH actual statistics are not at the disposal of the Special Correspondent, he is confident that when compiled they will show a record attendance at the sessions, and a minimum of tip-toeing out. To paraphrase the worthy Goldsmith, "Those who came to scoff remained to bray." The chief criticism heard was to the effect that one chairman brayed so much that the customers couldn't get in a word.

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THE Monday session started off promptly with the largest Monday crowd on record. Mr. Ransohoff described his system of cleaning and polishing as applied to wire nails with a modesty very becoming in a supplier, and maintained, throughout the discussion, a high degree of objectivity. The discussion ranged, as the committee has hoped, over the whole subject of nail making, especially on the finishing end. There was general agreement that the present cleaning and packaging is an anachronism, and a reproach to the industry. Patent medicines, cough drops, soda pop, and the like, speed happily through automatic machines representing millions of research dollars, while nails are so manhandled that a slot conveyor often represents the sole intrusion of the machine age into the pastoral scene. If cigarettes were packaged in a similar way few of us could afford to smoke them.

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MR. Morral's carefully documented report on the state of fused salt annealing, which it is understood will be supplemented by a second paper, was not of the type to provoke dissention, but the audience were in a talkative mood, and, ably led by Dr. Braley, who alternated between chairman and dispontant, they

kicked the salts around for nearly an hour. Both these papers would probably stand another review at some early meeting.

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TUESDAY morning's session, under the chairmanship of Ben McCarthy, was designed to be the highbrow session, with testing and metallurgy to the fore, but the audience kicked them around with about the same vigor and freedom that they had displayed with the homelier subjects. The Special Correspondent assumes that this freedom of discussion was due largely to the waiving of the requirement that names and company connections be stated by speakers from the floor, an excellent provision in principle but irksome to many a prospective speaker.

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THE chairman handled the discussion admirably, as could have been confidently predicted. It is easy to get irritated at Ben, he is so sure he is right, but as a matter of fact he generally is and knows and can prove it, and nobody ever doubts that he knows his subject, how to make it clear. A great teacher was lost to the world when Ben McCarthy went into industry.

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MR. Talmadge's paper dealing with spring wire led into a long discussion on testing methods and thence into an effort to center the blame for the non-uniformity that is the curse of wire for springs and for stampings. No conclusion was reached except that while wire made for other purposes is generally tested for a few inches in each mile, spring wire, whether coiled or formed, is tested for uniformity in practically every inch of its length, and is apt to look bad by comparison.

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THE second paper, by Messrs. D. A. Sutch and McCarthy, was to have been presented by Mr. Sutch, but as he has just been shifted to another of the Wickwire subsidiaries and could not be present, the chairman introduced himself, presented the paper, and acted in both roles during the discussion. Many old-timers were reminded, by contrast, of our early struggles with the identity of sorbite. The talk drifted toward electric patenting, and various interesting thesis were aired, some of which may be cleared up through an appeal to the electronic microscope.

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TUESDAY afternoon the session was handled by Jack Seymour, who can always be counted on to get action. Mr. Loux's paper on annealing concerned itself largely with the subject of atmospheres, and the discussion ran in the same direction. Mr. Loux should have been afforded a better chance to rebut some of the criticism which developed; the chairman of the committee slipped on this point and has expressed his regrets to Mr. Loux.

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MR. Hussey described the Herman process of galvanizing. A technique little known, but very favorably regarded by the users in its field of usefulness. It puts on a heavy coat of pure zinc with a very thin and flexible bonding layer, highly prized for rope wire, and for drawing down after coating, but of little interest today to fence manufacturers. The process was perfected just in time to run into the zinc shortage, which accounts in a large measure for its being so little known. Mr. Hussey suggests that it may easily adapt itself to the handling of other metals.

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THERE were several users present, but they were in perfect agreement among themselves, so the discussion was chiefly a matter of drawing out fuller descriptions of details of operation, in which quite a lively interest was displayed.

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WITH respect to the Wednesday morning session, the symposium on surface preparation, the Special Correspondent felt that for reasons which it is not necessary to go into he could not discuss it with the desired degree of objectivity. The reader can therefore imagine his relief when on stepping into one of the establishments adjacent to the lobby, for purposes that need not be particularized, he ran into our old friend Mr. J. J. Whoosis.

S. C.: Why Mr. Whoosis, this is a surprise. Are you out of jail?

J. J.: Obviously.

S. C.: Did you attend the Wednesday session? I should be glad to hear your comments.

J. J.: Yes sir; I attended every session. The luncheon was the best in my long experience. I don't mean the linoleum and gratin, I refer to the speaker. It's always a pleasure to hear a man who knows his subject set it forth so clearly, so concisely, and so entertainingly, and stop when he gets through. As for the Smoker, I have long since run out of adjectives to express my admiration for Gus Zapp's work. What a man! That's all I can say.

I liked the Mordica lecture too. It was like a release of tension. I liked it not only for its own sake, but as a reminder that we could easily get into a rut in this as in many other matters. A man who can make you stop and look into your own heart is a friend to cherish.

S. C.: But what about the technical session, Mr. Whoosis?

J. J.: I don't know just what to say. I thought it was a good idea, that symposium, and I expected a good result, but I came away with a feeling of frustration. I was even going to speak, but I never got a chance. I looked up Ken Lewis and intended to razz him about it but he was feeling so low I hadn't the heart. He says he got an attack of buck fever and missed an easy shot.

"Look, J. J.," Ken said, "I was counting on that coating discussion to develop so much information that we would cut off a cuple of years of fumbling. And then I had to mess it up! I had to fight like a tiger to get permission to put it on; th edirectors didn't believe it could be handled, and most of the experts were very dubious. I was about the only one that had faith that it could be made to click. Then when I stood up to open the meeting, I lost my faith. It came over me suddenly that my experts probably wouldn't give up more than a few words apiece, and that the audience wouldn't warm up, and I had a vision of having to turn the meeting out at about quarter of eleven, a complete bust. Absolutely without premeditation I opened my big mouth and wasted fifteen or twenty minutes with a useless introduction, just to fill time, then I found out that we had to get out by

twelve o'clock so the directors could throw a party for the luncheon speaker. My experts did a grand job, right in the spirit I had dreamed of, but the audience had to be cut off. I had wasted fifteen minutes myself, and together with my ignorance about the directors' party that killed the hour that the audience would have enjoyed. I found out later that they were loaded with stuff for the discussion.

Now I'm in the dog house for fair. Harold Trembicki had his rebuttal cut off, the experts lost theirs, the audience lost everything. John Callaghan could have killed me. I was going to run in the Submerged Combustion paper too. Hank Snowden couldn't get to the convention, but I had three users lined up to toss it around, one of whom has thirteen installations in his company, and if Walter See ever speaks to me again I'll be too surprised to answer. Now I find I can't get any cyanide without a doctor's prescription."

I said "Cheer up Ken; we all make mistakes, probably you did **some** good."

"Yes," he said, "I did accomplish something. I set out to prove that certain changes in procedure would tend to create an atmosphere in which free discussion would flourish, and I think I made my point. That's something. Also I messed up the thing just enough so they won't ask me to head up the program committee again, and **that's** something."

* * * *

"Thank you very much, Mr. Whoosis," said the S. C. "Now tell me, if you will—" but as he looked up from his note book he found himself alone. Mr. Whoosis had dematerialized.

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The Non-Ferrous Technical Sessions

THE first paper of the technical sessions on a non-ferrous subject was given Wednesday afternoon, October 17th, at 3:30 P.M. by Matthew J. Donachie, consulting metallurgist of the Beryllium Corporation, of Pennsylvania, the title of which was "Working Habits of Beryllium Copper Wire." Sidney Rolle was in the Chair. It was generally admitted that this was one of the outstanding papers given at this year's meeting and many said it was the best. While Mr. Donachie approached the problem from the practical standpoint of the mill operator, his reasoning was based on sound metallurgical knowledge backed up by actual experience. He showed a number of interesting lantern slides, which greatly helped in understanding the ideas he was trying to put across. It was evident from the reception given his paper that his opinions are valued highly. Written discussions were submitted by H. S. Freynick of Riverside Metal Co., S. C. Avallone, metallurgist, Spencer Wire Co., West Brookfield, Mass., and J. Ogden, Works Manager, Little Falls Alloy Co., Paterson, N. J. These will appear in the January 1946 issue of Wire & Wire Products.

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THE discussion from the floor was animated and at all times very much to the point. Mr. Donachie's answers were clear and precise.

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THE Thursday morning session opened with a very elaborate paper by Dr. Carl Shapiro, president, General Materials Research Laboratories, the title of which was "Insulating Wires with Vinyl Resins." Dr. Shapiro was unfortunately unable to be present so the Chairman, Mr. Kenneth H. Davis, gave a very good resume of it. Although the chairman apologized by saying that he was not up on the subject, it was quite evident that he had read the paper carefully and at least knew what the author was driving at. Written discussion was submitted by Messrs. Ralph Hall, chief engineer of Phelps Dodge Copper Products Co. and J. D. Winters, of the Plastoid Corporation. These discussions will be published in the January 1946 issue of Wire and Wire Products. The principal point brought out by Mr. Hall was the rather startling omission in Dr. Shapiro's paper regarding Formbar, the Vinyl resin developed by the General Electric Co. It was commented upon by some of the members present that one member arose to correct the statement by saying that Dr. Shapiro did mention this material but only very scantily. Mr. Davis handled the session admirably.

THE second paper of the session was presented by C. B. Shopmyer of The General Electric Co. This paper proved to be most interesting and in addition to the written discussions presented by B. J. Sirois of Phelps Dodge Copper Products, D. P. Hall of Kennecott Wire & Cable Co., C. J. Snyder, Anaconda Wire & Cable. The discussion from the floor was lively.

✦ ✦ ✦

MR. Shopmyer's paper was well prepared and showed clearly the method and apparatus they developed at G. E. for Measuring Wire Stiffness by Low Stress Elongation. Mr. Shopmyer stated that not only does this company use the apparatus for measuring the stiffness of the wire they produce from various brands of copper, but also are using it in testing the finished product before shipping. He said that many of their customers are also using it in testing the wire received from various supplyers.

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THE afternoon session was presided over by Mr. Rolle, who first called on Mr. A. Pirk, metallurgist of Rome Cable Corporation to present his paper entitled, "Trends in Metallurgy." This paper proved to be a general but thorough review of the newer trends in metallurgy of the metals used in the production of wire, but in each case Mr. Pirk gave the underlying basic principles. It was the concensus that while most of those present were well acquainted with the facts brought out by Mr. Pirk, it was well for all to periodically go back to first principles. As one member put it, the paper was sort of a "refresher course."

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WHILE Mr. Pirk took nearly an hour and a half, to present his paper, none of those present seemed to mind very much. He had a very large number of slides, many of which were used as figures in the paper which was published in full in the October issue of W. & W. P. No written discussion was submitted but the discussion on the floor was animated.

(*Please turn to page 881*)

GOVERNMENT WIRE PRODUCTION INFORMATION

Functions of The Civilian Production Administration

J. D. Small, newly named Administrator of Civilian Production Administration, which succeeds WPB, recently outlined in detail the functions of the new agency.

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"THE War Production Board's task of production for war has been completed and WPB's record of accomplishment during the war years speaks for itself," Mr. Small said. The Civilian Production Administration will take over, and will carry forward, those remaining WPB function and controls that are required during the transition period of reconversion to accomplish the objectives laid down by the applicable federal statutes and Executive Orders of the President, including particularly the War Mobilization and Reconversion Act of 1944 and the recent executive order of the President outlining the policies to be followed in the transition from war to peace. The functions transferred to the new office will be utilized to further a swift orderly transition from wartime production to a maximum peacetime production in industry free from wartime Government controls with due regard for the stability of prices and costs.

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"IT will use its authorized powers to expand the production of materials which are in short supply; limit the use of materials which are still scarce; restrict the accumulation of inventories so as to avoid speculation, hoarding, and unbalanced distribution which would curtail total production; grant priority assistance to break bottlenecks which would impede the reconversion process; facilitate the fulfillment of relief and other essential export programs, and allocate scarce materials or facilities necessary for the production of low priced items essential to the continued success of the stabilization program."

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THE executive order creating the Civilian Production Administration as a separate agency carrying out the policies of the Director of War Mobilization and Reconversion, transfers to it on November 3, 1945, all the still remaining functions, powers, personnel, records, etc., of the War Production Board. Any outstanding WPB regulations, directives, orders, or delegations of authority remain in full force and effect as instruments of Civilian Production Administration, until revoked or amended by that office. Mr. Small explained, however, that the individual CPA controls will be

(Please turn to page 872)

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CONTINUOUS IMPROVEMENT

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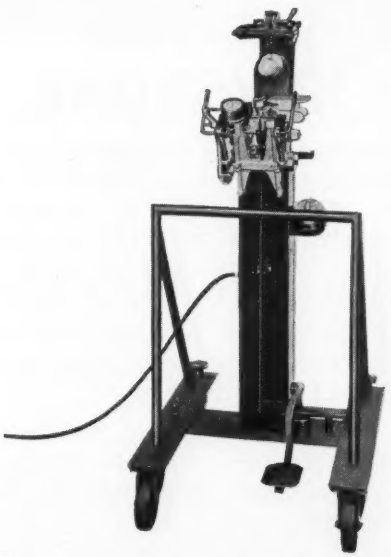
There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



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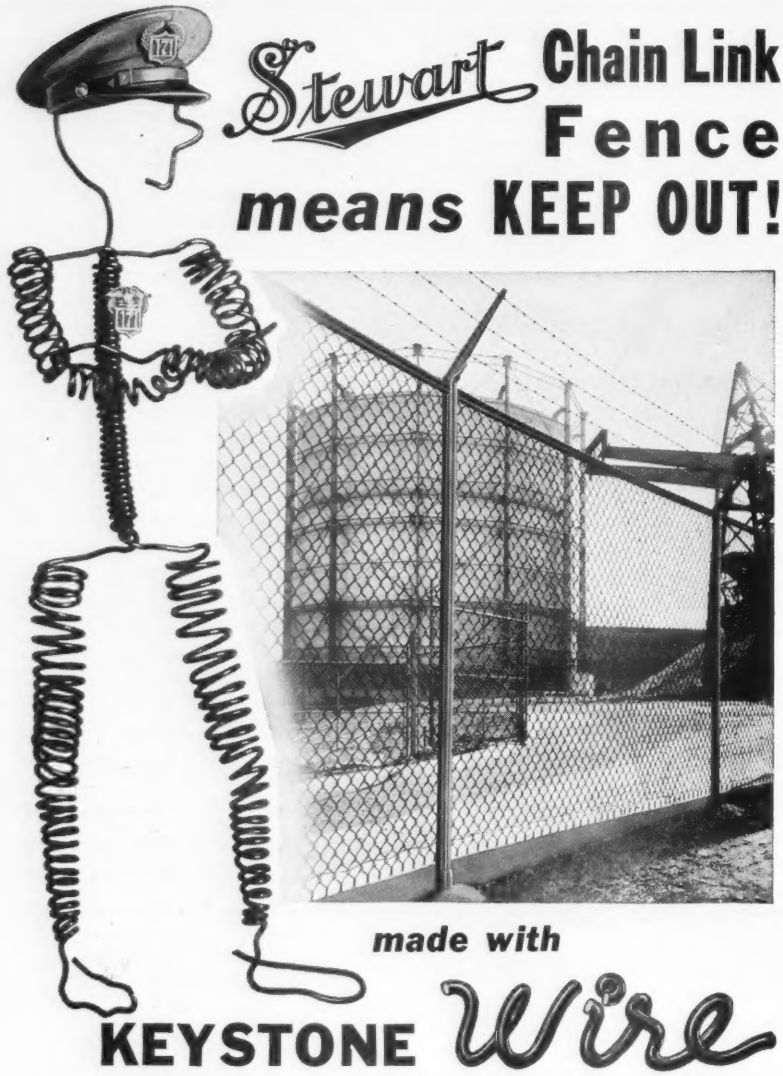

Stewart Chain Link Fence means KEEP OUT!

made with KEYSTONE Wire

"Keep Out" takes on definite meaning when the premises are enclosed with Stewart Chain Link Fence . . . literally an iron-clad "stop" to would-be trespassers. That's why you'll find countless miles of Stewart Chain Link Fence around industrial plants, warehouses, storage yards, as well as airports, institutions, parks and estates from coast to coast.

Into this rugged protective fence the Stewart Iron Works Company of Cincinnati, Ohio, annually fabricates thousands of tons of Keystone wire.

Stewart, a company with 60 years of established reputation, finds in Keystone wire the uniformity of quality, easy fabrication and durability that help them sell their product and *keep it sold.*

KEYSTONE STEEL & WIRE COMPANY
PEORIA 7, ILLINOIS

Special Analysis Wire for All Industrial Uses

SAMSON SPRING WIRE — Reg. U.S. Pat. Off. — Keystone Steel & Wire Co. Peoria, Ill.

Coppered, Tinned, Annealed, Galvanized

Government Wire Production Information

(Continued from page 871)

lifted as soon as each is no longer needed for orderly reconversion.

✦ ✦ ✦

"THE functions of the five bureaus operating under Civilian Production Administration are generally planned to be as follows:

(1) Industrial Reconversion Operations—This bureau will deal with problems affecting particular industries which produce or consume scarce raw materials and products such as rubber, forest products, tin, lead and some other minerals, some construction materials, a few textile items and chemicals, and various hard goods and equipment items.

(2) Reconversion Priorities—This bureau will be responsible for the modification of general priorities and allocation controls (as distinct from the problems of particular industries), the internal clearance of agency actions, appeals, inventory problems compliance, and relationships with other government agencies.

(3) Field Operations — is concerned with operations in the field including compliance.

(4) International Supply — is concerned chiefly with imports, exports and international allocations.

(5) Demobilization—covers functional demobilization and transfers, budget, personnel, administrative services, and records."

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Brass Mill Production

THE brass mill industry's outstanding accomplishment in achieving a 400 per cent production increase during the war was graphically portrayed in a chart released recently by the War Production Board's Copper Division.

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A production increase of this magnitude was considered virtually impossible at the beginning of the war, according to C. L. Homer, Chief of the Brass Mill Section of the Copper Division.

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"WHEN the industry was called upon for 'all out' production for heavy ammunition following the German break-through last December, it responded and by March, 1945, pushed brass mill production to a record monthly peak of 517,539,000 pounds," he said.

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THIS production record compares with an average peacetime monthly total of around 100,000,000 pounds, according to the estimate shown on the chart.

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AUGUST production continued the declining trend in evidence since V-E Day, dropping to 175,725,000 pounds from 201,572,000 pounds in July.

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MR. Homer predicted that brass mill production could be expected to level off around 150,000,000 pounds monthly for a considerable period. While this figure is approximately 50 per cent above prewar monthly levels, pent-up reconversion needs would probably keep demand high for some time, he said.

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AT the same time, the resignation of Mr. Homer was announced. He expects to become associated with the Bridgeport Brass Company within the next few days. Mr. Homer headed the brass mill section during the entire war period. For six months he served in this capacity while he was a Lieutenant (Sr. Grade) in the United States Navy. Mr. Homer is a native of Fairfield, Conn.

✦ ✦ ✦

ISSUANCE of a new regulation superseding all others governing sales of electrical wire and cable has been announced by the Office of Price Administration effective October 29, 1945.

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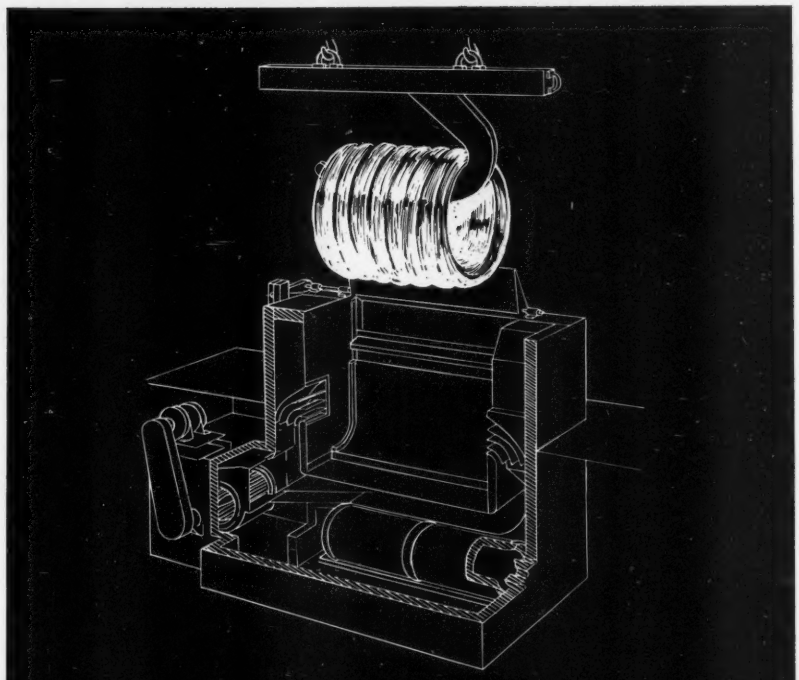
THE new regulation, which will be known in the industry as Maximum Price Regulation No. 82—Wire and Cable—is a revision of Revised Price Schedule 82—Wire, Cable and Cable Accessories—and will include on its pricing lists every type of wire conducting electricity, including aluminum and nickel-alloy. The old regulation, OPA said, priced only copper, copper-clad and copper alloy wire.



Cutaway view of flash baker that broke a wartime bottleneck in the wire industry by accomplishing in minutes what formerly took hours. Over 70 installations involving this basic design are now in operation in every section of the nation.

This BAKER possesses TWO VITAL FACTORS that cannot be pictured

Best Method of Heating — **determined by a searching analysis of the factors involving gas — oil — electric — direct and indirect heating.**

A Production Layout and Handling System — **uninhibited by the past and shrewdly calculated to utilize the generation of engineering and construction progress which has been crowded into the last few years.**

Here at Morrison Engineering, we focus our thinking on furnaces and ovens as production machines, an integral part of the production line, not just so much brick, steel and insulation.

We welcome the opportunity to discuss your needs on any wire process requiring heat.

Call Cleveland HEnderson 6666

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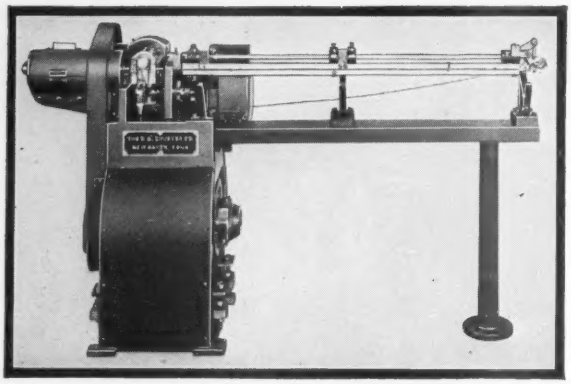

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Wire Capacity 1/32" - 1/16" Diameter

Faster Cutting Speeds
GREATER PRODUCTION!

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Outstanding Features—

Almost continuous wire travel
Lightning cut-off assures square-cut ends
High speed, direct driven 5-die straightening flie·
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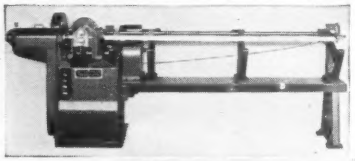

Type 1A
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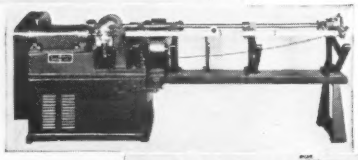
Dia.



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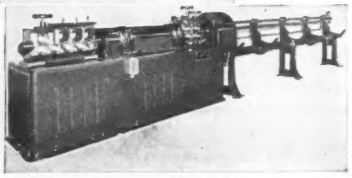

Type 3A
3/16" - 3/8" Dia.

Type 4A (not shown)
3/8" - 5/8" Dia.

The F. B. Shuster Mfg. Co., Inc., New Haven, Conn.

SHUSTER
Automatic
WIRE STRAIGHTENING
AND CUTTING
MACHINES
Since 1866

Government Wire Production Information

(*Continued from page 873*)

Diamond Controls Relaxed

DISTRIBUTION controls over industrial diamonds have been relaxed by WPB by an amendment to M-109.

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HENCEFORTH the board will exercise controls only over monthly sales of industrial diamonds in the amount of 1,000 carats or more and diamond powder (crushing bort) in the amount of 250 carats or more. Formerly distributive controls were maintained over monthly sales of industrial diamonds totaling 100 carats and crushing borts of 25 carats.

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THE WPB said that inasmuch as parallel controls over industrial diamonds are in effect in Great Britain, a similar relaxation may be expected in that country.

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Atomic Power May Be Derived From Wire

EVERYBODY else seems to have had a hand in the development of the atomic bomb, so that it is interesting to note that the wire industry may have a role to play in the future application of atomic power for peacetime purposes.

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MR. Gerald Wendt, New York research chemist and writer on scientific subjects believes that motive power in the form of atomic energy could be derived from wire. Said he in a recent talk before a meeting of the committee for economic development: "Atomic fuel could be supplied in the form of fine wire (of atomic explosive) on a spool which can be fed into the nozzle of a jet engine. If it disintegrates at a controlled speed, all that is needed is a blast of compressed air over it. Heated by atomic energy, this air would expand and roar out of the rear nozzle. Once that is accomplished the same hot air blast could be blown on an air turbine wheel to operate propellers of a plane or ship, to propel a locomotive, or to run any engine."

Outstanding Personalities of the Wire Industry

John Graham, General Sales Manager, American Steel and Wire Company

THE appointment of **John Graham** as general manager of sales of the American Steel & Wire Co. is announced.

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BORN in Brooklyn, N. Y., in December, 1896, Mr. Graham has been associated with the United States Steel Corp. since he worked during vacations as a messenger in the New York office. In January, 1911, he became a permanent employe when he was hired as an office boy in the New York office of the American Steel & Wire Co. He worked his way up through the ranks in New York until in August, 1930, he was named manager of the New York sales office. In April, 1937, he was transferred to Cleveland as manager of the manufacturers products sales, and in July, 1942, he was named assistant to vice president.

✦ ✦ ✦

R. F. Sentner, Assistant General Sales Mgr., Wheeling Steel Corp.

Richard F. Sentner has been appointed an assistant general sales manager of the Wheeling Steel Corporation, effective October 1st.

✦ ✦ ✦

MR. Sentner has been manager of Tin Plate Sales since 1941, but during the past three years has been with the War Production Board in Washington. Originally serving as Chief of the Tin Plate Unit, his last assignment was Deputy Director of the Steel Division.

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MR. Sentner became associated with Wheeling Steel in 1927 as a salesman in the New York Office. In 1933 he went to the Wheeling Main Office as assistant manager of tin plate sales, becoming manager of that Division in 1941.

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Carl H. Langendorf Appointed Surface Combustion Sales and Service Engineer for St. Louis

Carl H. Langendorf has been appointed sales and service engineer for its St. Louis territory, Surface Combustion Corporation, Toledo, O., announces.

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MR. Langendorf was assistant office manager of McDonnell Aircraft Co. before returning to the Toledo organization. The company manufacturers Janitrol gas-fired space heating equipment and Surface Combustion industrial furnaces. Langendorf had been with the heating equipment manufacturer prior to joining the aircraft company in 1943 and formerly was with the Laclede Gas Company's house and commercial heating department for 10 years.

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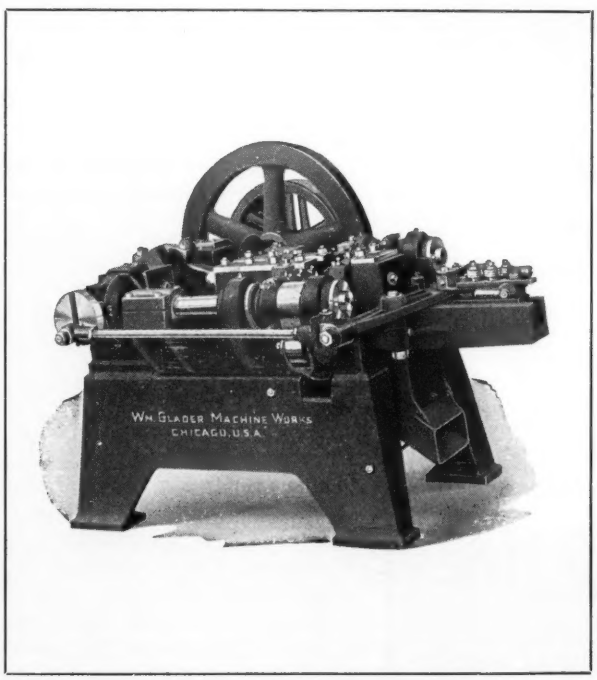
(Please turn to page 876)

GLADER HIGH SPEED WIRE NAIL MACHINE



High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS

210 NO. RACINE AVE.

CHICAGO 7, ILLINOIS

Outstanding Personalities of the Wire Industry

(Continued from page 875)

Hartley Wire Die Appointed Carboloy Agent for New England

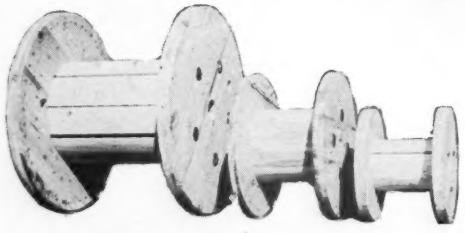
ANNOUNCEMENT is made of the appointment of the **Hartley Wire Die Company,** Thomaston, Connecticut, as exclusive Carboloy die manufacturing agent for the manufacture and sale of special dies in the New England territory. This will supplement the present sales and service of Carboloy Company on **standard** Dies which will continue to be handled direct as in the past.

Norman Sted, Assistant Manager, Manufacturers Products Division, American Steel and Wire Co.

BORN in Cleveland, Ohio, on August 21, 1907, **Mr. Sted** has worked for the Wire Company since June, 1926, when he was made an office boy in the order department. He was given a series of promotions until in April, 1939, he was named office manager of the Cleveland district sales department. Since December, 1943, Mr. Sted has been assistant to the manager of Cleveland district sales.

✦ ✦ ✦

WOODEN . . . REELS



RETURNABLE and NON-RETURNABLE

For CABLE, ROPE and WIRE

(from 12″ to 96″ in diameter)

These reels are made to customers' specifications in an up-to-date plant. Production methods assure lowest possible costs. Reels are sturdy and will withstand severest handling.

We can also make your reel heads for steel drums

Let us quote on your requirements

The BRIDGE MFG. CO., Inc.

HAZARDVILLE, CONN.

American Steel and Wire Co. Announces Appointments

C. H. **Schiller** has been appointed manager of market research and sales analysis for the American Steel & Wire Co., subsidiary of United States Steel Corp. At the same time, H. M. Ridlon has been named assistant manager of the same division, and A. W. Ruttkamp, formerly manager, has been assigned special duties for the general manager of sales.

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MR. **Ruttkamp** first started working for American Steel & Wire Co. in 1906. In the intervening years, he has held a number of positions and since October, 1940, has been manager of the market research and sales analysis division.

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FIRST employed as a tester at American Steel & Wire Company's North Works at Worcester, Mass., **Mr. Schiller** has worked for the Wire Company since June, 1933. In 1939, he was transferred to Cleveland as a market analyst and in October, 1943, he was named assistant manager of the division which he now heads.

✦ ✦ ✦

MR. **Ridlon** started working for American Steel & Wire in September, 1930, as a technical apprentice at Electrical Cable Works, also in Worcester. Since September, 1942, he has been a market analyst with offices in Cleveland.

✦ ✦ ✦

D. R. Yarnall President American Society of Mechanical Engineers

D. **Robert Yarnall,** president of the Yarnall-Waring Company of Philadelphia was elected president of the American Society of Mechanical Engineers, succeeding Alex D. Bailey of Chicago.

✦ ✦ ✦

AMONG other newly elected officers are Alexander R. Stevenson, Jr., General Electric Company, Schenectady, vice president; Rudolph F. Gagg, Wright Aeronautical Corporation, Paterson, vice president; Edgar J. Kates, consulting engineer, New York, and J. Noble Landis, Consolidated Edison Company, directors-at-large.

✦ ✦ ✦

Clark W. King Executive Assistant of Allegheny Ludlum Steel

THE appointment of **Clark W. King,** as executive assistant was announced recently by Hiland G. Batcheller, president of the Allegheny Ludlum Steel Corporation, Brackenridge, Pa.

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MR. King comes to Allegheny Ludlum after more than four years' service with the Steel Division of the War Production Board, Washington, where he served continuously as Special Assistant to each of the seven successive directors of that division. While in Washington, Mr. King was on detached service with the Bethlehem Steel Company, Bethlehem, Pa.

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FROM 1928 to 1935, Mr. King was with the American Steel & Wire Company's New York sales office, having, however, been granted leave from that company from 1933 to 1935, to serve under the Board of Directors of the American Iron & Steel Institute, in the administration of the N.R.A. Steel Code. He then joined the Commercial Research and Industrial Development Division of the Bethlehem Steel Company, and in 1941 took up his duties with the War Production Board.

✦ ✦ ✦

R. F. Curtis, Mgr., Manufacturers Products Division, American Steel and Wire Co.

MR. **Curtis** was born in Framingham, Mass., on September 29, 1895. He was graduated from Clark College in Worcester, Mass., in 1915 with an A.B. degree. In 1917, he received his A.M. degree from Clark University, Worcester, after having majored in chemistry, physics, and biology. Mr. Curtis first worked for the Wire Company in January, 1920, as a foreman at Worcester, Mass. In June, 1925, he was transferred to the New York sales office as a correspondent, and in October, 1930, he was made assistant manager of sales at Philadelphia. In April, 1937, Mr. Curtis was transferred to Cleveland as assistant manager of the manufacturers products division, which post he has held to the present time.

✦ ✦ ✦

H. J. French, Asst. Mgr. of the Development and Research Div., International Nickel Co., Inc.

H. J. **French** has resigned as assistant director for raw materials and facilities of the Steel Division, War Production Board, Washington, D. C., and has resumed his duties as assistant manager of the Development & Research Division of the International Nickel Co., Inc., New York. He leaves Washington after 42 months' service with the WPB.

✦ ✦ ✦

John R. North Joins Morgan Construction Company

John R. **North** recently joined the Morgan Construction Co., Worcester, Mass., as engineer in its wire machinery department. Since graduating from Massachusetts Institute of Technology in 1929, he has been associated with the Wickwire Spencer Steel Co. at Palmer, Mass., where he served for the past few years as assistant superintendent.

✦ ✦ ✦

(Please turn to page 878)

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Since 1912, manufacturers of wire drawing and annealing, and shipping spools and reels.
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Outstanding Personalities of the Wire Industry

(*Continued from page 877*)

David F. Austin, Vice President of United States Steel

THE election of **David F. Austin** as vice president, sales, United States Steel Corporation of Delaware was recently announced. Mr. Austin has been acting vice president since June 20, 1945, during which time he continued as vice president in charge of sales, Carnegie-Illinois Steel Corporation.

HE began his career with United States Steel as an office boy in the corporation's New York office late in 1918, served in various capacities with the real estate department of the Carnegie Steel Company until 1927 when he was transferred to the sales department, entering the company's sales school. After working as a salesman in four different sales territories, he was advanced to assistant district manager of sales, Cincinnati, following which he served successively as district manager of sales in Cincinnati, Pittsburgh and Chicago.

MR. Austin was elected January 1, 1938, as vice president in charge of sales, Carnegie-Illinois Steel Corporation, in which capacity he served until his current advancement.

✦ ✦ ✦

FROM January 1942, until July 1943, Mr. Austin served with the War Production Board, becoming successively assistant director, deputy director and acting director of the board's steel division.

✦ ✦ ✦

Charles H. Saiter, Sales Manager, Heavy Machine Division, Cleveland Crane and Engineering Co.

Charles H. Saiter has been appointed sales manager of the heavy machine division of The Cleveland Crane and Engineering Company, Wickliffe, Ohio. This is a new sales division which will be responsible for the sales of heavy Cleveland overhead traveling cranes, as well as Steelweld bending presses, bulldozers and special machinery. Until recently the Steelweld line of machines was distributed through a general sales agent.

✦ ✦ ✦

MR. Saiter was sales manager of the former Heavy Crane Department, and has been with the company for 23 years in various engineering and sales capacities.

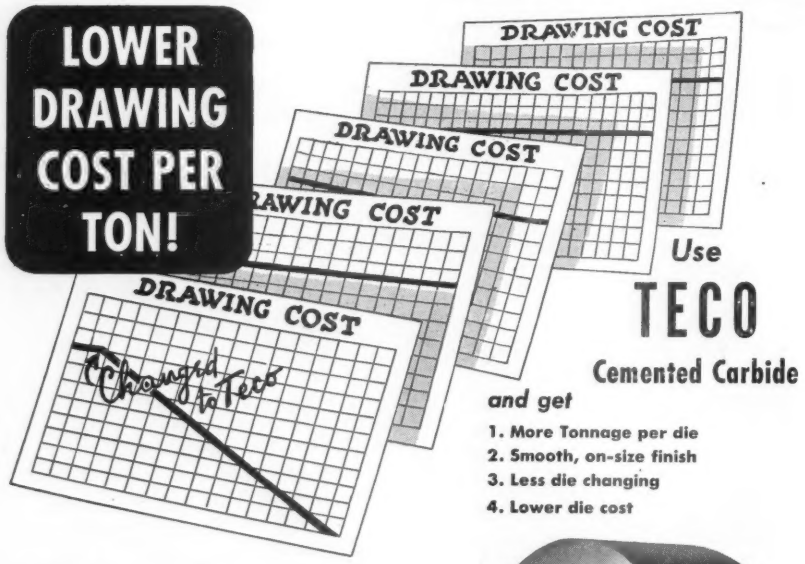
✦ ✦ ✦

J. H. Vail, Asst. Director Industrial Relations, American Steel and Wire Company

J. H. Vail has been appointed assistant director of industrial relations of the American Steel & Wire Co., subsidiary of United States Steel Corp. Mr. Vail will be transferred to the Cleveland office from Duluth, Minn., Works where he has been supervisor of industrial relations.

✧ ✧ ✧

MR. Vail has been associated with the Wire Company since Au- the Company since August, 1933, when he started as a tester and gauger at North Works, Worcester. He held various positions at that plant and the Trenton, N. J., Works before being transferred to Cleveland in June, 1941, as assistant personnel manager. He has been located in Duluth since June, 1943.



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TECO Cemented Carbide cuts costs as efficiently as it draws wire! TECO produces more tonnage per day — getting the most out of each machine-and-labor dollar. TECO holds on-size longer — reducing unproductive die changing. TECO remains highly productive for the full life of the die — lowering your die costs.

Credit maximum resistance to wear and pitting for this remarkable cost-cutting performance . . . achieved by combining the correct qualities of hardness, density and uniformity in every TECO Cemented Carbide Die.

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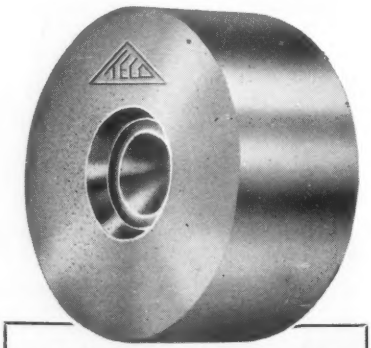

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A Review of Recent Wire Patents

No. 2,383,964, COATING METHOD AND APPARATUS, patented September 4, 1945 by William F. Grupe, Lyndhurst, N. J., assignor to Interchemical Corporation, New York, N. Y., a corporation of Ohio.

✦ ✦ ✦

This method comprises maintaining the strip under tension; covering one side of it with an excess of the coating material; and bending the coated strip transversely through an angle of from 3° to 30° by breaking the strip and drawing it over a small diameter bar with the coated side in contact with the bar, the amount of tension and the angle of bend being sufficient to cause the bent strip to become entirely flat along the line of bend, so as to obtain complete contact between the strip and the bar throughout the width of the strip, but insufficient to cause a permanent deformation thereof.

✦ ✦ ✦

No. 2,384,038, MINE SWEEPING CABLE, patented September 4, 1945 by David Larkin, Kirkwood, Mo., assignor to Broderick & Bascom Rope Company, St. Louis, Mo., a corporation of Missouri.

✦ ✦ ✦

The cable is made up of cutting strands laid up spirally, the cutting strands comprising a core and alternate cutting and supporting wires mounted spirally thereabout.

✦ ✦ ✦

No. 2,384,264, SLOTTED SCREW, patented September 4, 1945 by Ernest Schlueter, Hollis, N. Y.

✦ ✦ ✦

Complete Descriptions and Drawings of Patents May Be Had for 25 cents; outside United States and Canada, $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

A slot is provided with a longitudinally concaved bottom having concaved deeper grooves at the side margins respectively; the intramarginal part between the grooves being raised relative to the grooves and serrated.

✦ ✦ ✦

No. 2,384,275, WIRE DRAWING MACHINE, patented Semtember 4, 1945 by Bruce N. Bletso, Cleveland, Ohio, assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

✦ ✦ ✦

More specifically, this patent comprises one claim to a wire drawing mill layout including a number of wire drawing machines, arranged in side-by-side alignment. The operators may remove wire bundles without walking around the machines or crossing the stock feeding to the die box.

✦ ✦ ✦

No. 2,384,351, METHOD OF FORMING EXTENDED LENGTHS OF METAL WIRE, patented September 4, 1945 by George H. Slagle, Temple, Pa., assignor, by mesne assignments, to Berks County Trust Company, Reading, Pa., a banking institution of Pennsylvania.

✦ ✦ ✦

In the manufacture of wire consisting of a beryilium-copper alloy containing 1.5 to 3% Be, the improvement comprises forming the alloy into an elongated strip having a width relative to its thickness adapted, on slitting lengthwise, to provide a number of identical square cross-sectioned lengths; slitting this strip into square cross-sectional lengths; end butt-welding the square cross-sectional lengths together to form an extended length; annealing the extended length to condition the same for cold working, cold rolling the annealed length to round section, and cold drawing the round sectioned length to smaller diameter.

✦ ✦ ✦

No. 2,384,403, STUD, patented September 4, 1945 by Robert E. Somers, Hellertown, Pa., assignor to Bethlehem Steel Company, a corporation of Pennsylvania.

✦ ✦ ✦

The Stud is adapted to be end welded and comprises a body portion, a current receiving end portion, a welding end portion, and a flux coating on said portion adjacent this welding end portion.

✦ ✦ ✦

No. 2,384,467, PICKLING INHIBITORS, patented September 11, 1945 by William H. Hill, Mount Lebanon, Pa., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine.

✦ ✦ ✦

For pickling iron, the inventor provides a non-oxidizing acid pickling solution and a condensation product of formaldehyde

✦ ✦ ✦

(Please turn to page 880)

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JANUARY ISSUE OF

WIRE AND WIRE PRODUCTS

This is our POST-CONVENTION SPECIAL ISSUE, containing the discussions on technical papers presented at the Annual Convention of the WIRE ASSOCIATION.

IN ADDITION

— THE MORDICA MEMORIAL LECTURE FOR 1945 —

By John C. Callaghan,
Works Manager, Canada Works,
Steel Company of Canada, Ltd., Hamilton, Ontario, Canada

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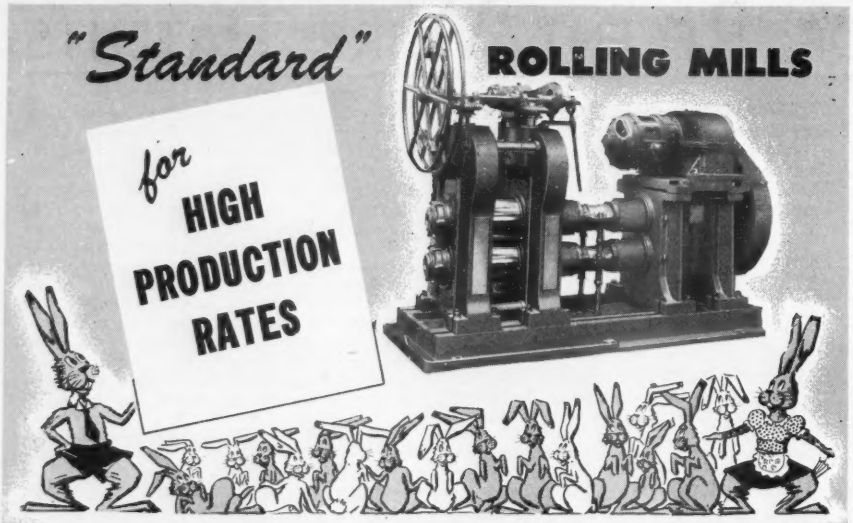

"Standard" Rolling Mills assure high production hot or cold rolling of your strip, rod or ingot. Speeds are provided for rolling metals in any range from 10 feet to 500 feet per minute, depending upon your needs. Two, Three, or Four High Mills are available with roll sizes from 1½" diameter and 1" face to 16½" diameter and 18" face.

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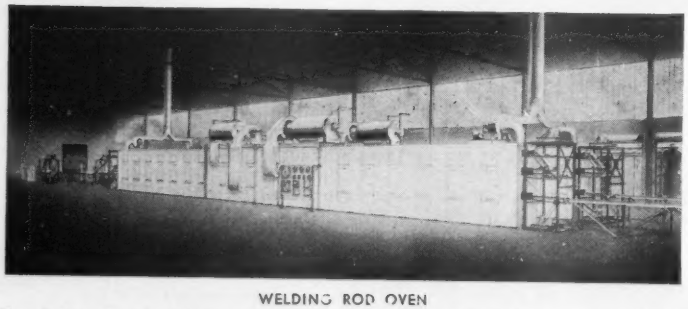
The fastest rod baker built! Saves up to 50% in time and fuel. Patented Blow-Off Feature removes moisture without bumping or agitating the coils. Patented and patents pending.



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Wickwire Spencer Steel Co.

WRITE for BULLETIN No. 211

THE CARL-MAYER CORPORATION 3030 EUCLID AVENUE CLEVELAND, OHIO

A Review of Recent Wire Patents

(Continued from page 879)

with the reaction product of hydrogen sulfide and a guanidine.

✦ ✦ ✦

No. 2,384,895, ATTACHMENT FOR SCREW MACHINES, patented September 18, 1945 by Samuel P. DeMato, Rochester, N. Y., assignor to James Cunningham, Son & Company, a partnership composed of Augustine J. Cunningham and Francis E. Cunningham, Rochester, N. Y.

✦ ✦ ✦

So as to adapt a screw machine to cut light threads, the inventor provides a portion formed at one end with a socket for a die holder and at its other end with a shank for insertion in a tool socket, a die holder provided with threading dies and having a shank movable longitudinally in this socket, a hand lever pivoted on the portion, and means connecting the lever and die holder for manually moving the die holder to bring the dies thereof into threading engagement with the work.

✦ ✦ ✦

No. 2,385,137, PREPARATION OF DIAMOND DIES FOR WIRE DRAWING, patented September 18, 1945 by Alan Edgar Jones, Prescot, England, assignor to British Insulated Cables Limited, Prescot, England, a British company.

✦ ✦ ✦

In preparing a hole in a diamond die for wire drawing, the patentee feeds into the space between the needle or wire operating member and the surface of the hole in the diamond, diamond powder suspended in cyclohexanol.

✦ ✦ ✦

No 2 385.241, ROPE, patented September 18, 1945, by Edward Horace White, Warrington, England, assignor to The Whitecross Company Limited, Warrington, England.

✦ ✦ ✦

A non-twisting rope is claimed, consisting of a core comprising a number of layers of wire wound to one hand, two layers of wires disposed around this core, these layers both being laid to the same hand but to the opposite hand from that of the core, and in which there is a twist in all the layers of the core with respect to the first or inner layer of the two covering layers, the sectional areas of the core layers multiplied by their respective distances from the center being not less than the sectional area of the two outer layers multiplied by their respective distances from the central axis of the rope.

✦ ✦ ✦

No. 2,385.357, METHOD OF RECESSING WIRE COILS, patented September 25, 1945 by Otto Haas, Richmond Hill, N. Y., assignor to Aircraft Screw Products Company, Ind., Long Island City, N. Y., a corporation of New York.

✦ ✦ ✦

In order to provide a cylindrical wire coil, having a notch or recess on a peripheral side of one of its end convolutions, the inventor winds a wire in a cylindrical coil of desired shape, diameter and pitch of the finished product, bending an arc portion of the end convolution from its original position in relation to the subsequent convolution, working a notch or recess of desired shape into this arc while holding it in the bent position, releasing the arc from hold and restoring its original position in relation to the subsequent convolution.

Wire Association Convention Notes

(*Continued from page 870*)

THE second paper of the session was one entitled: "Metallurgy of Copper and Its Relation to Magnet Wire Manufacture," by W. L. Fleishmann of General Electric Co., Fort Wayne, Indiana. Mr. Fleishmann was unable to be present and the Chairman therefore undertook to read it.

✦ ✦ ✦

WRITTEN discussion was submitted H. M. Schleicher of U. S. Metals Refining Company, Carteret, New Jersey. This will be published in the January 1946 issue of Wire & Wire Products.

✦ ✦ ✦

IT was very evident from the discussions from the floor that the opinions voiced by Mr. Fleishmann were not acceptable. There appeared to be not only differences of opinion regarding the facts but also regarding the conclusions drawn by the author. He also failed to make mention of Oxygen Free Copper now widely used for magnet wire.

✦ ✦ ✦

ALTHOUGH the attendance at the Non-Ferrous session was smaller than that at the Ferrous, the interest shown by the members was keen. Many were positive in asserting that this year's session clearly proved that with thorough and careful preparation the Non-Ferrous Technical Session can be made interesting and informative. Everyone agreed that the written discussion added considerably to the value and interest of the papers themselves.

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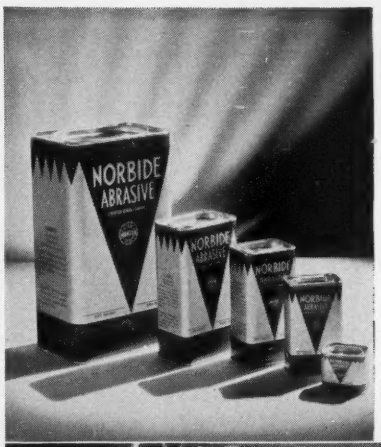

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NORBIDE Abrasive is extensively used as a successful medium for cutting and semi-finishing cemented carbide wire drawing dies. NORBIDE is second only to the diamond in hardness, yet this abrasive costs but one hundredth as much. Sizes 220 and 240 are recommended for ripping operations, 320F for a semi-polish, 500 to 800 for final finishing.

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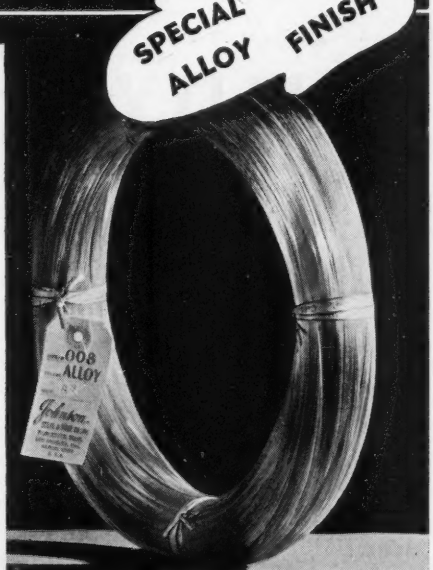

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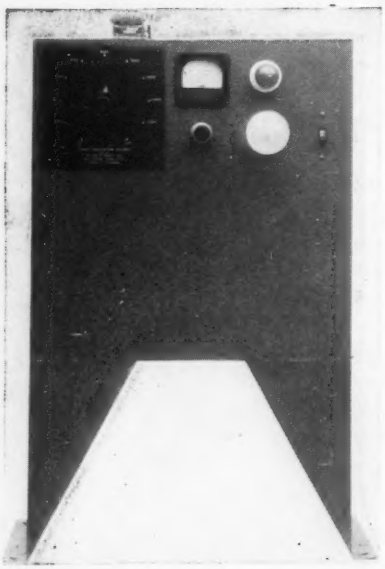
SPARKER for SYNTHETIC EXTRUSION COMPOUNDS



THIS APPARATUS WILL LOCATE DIELECTRIC FAULTS while the wire is being insulated. When breakdown occurs, the operator is notified by an audible alarm. A resettable counter gives the number of faults in each reel. By sorting out the defective reels in this operation, the majority of the resparking is eliminated. Continuous range of voltage at the electrode is from one thousand to sixteen thousand volts. The sparker is equipped with voltmeter reading in kilovolts, and automatic interlock with the take-up motor.

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For users of wire

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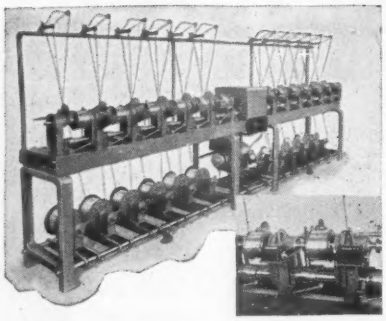

Every winding head equipped with large-figure footage counters, conveniently located for inspection and control by operator.

This double-end, screw traverse FIDELITY Wire Spooling Machine is a high production unit. It winds wire at the rate of 600 to 700 feet per minute per spool.

On the 12-head machine illustrated, this totals about one and one-half miles per minute. Allowing time for changing spools, this makes possible the winding of 600 or more miles per 8-hour shift.—Accommodates spools up to 9¼" diameter. Adjustments for tension, flange variations and spool sizes. This same machine built in units handling 4-6-8-10 and 12 spools.

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27th National Metal Exposition Cleveland Public Auditorium February 4 Thru 8, 1946

PLANS have been completed for the first great postwar industrial show with the announcement this week of the 27th National Metal Exposition to be held in Cleveland's big Public Auditorium from Monday, February 4, through Friday, February 8, 1946. Originally scheduled for October of this year, the event was moved back to February to avoid any interference with heavy wartime transportation demands, according to **W. H. Eisenman,** managing director of the Exposition and national secretary of the American Society for Metals, sponsor of the event.

✧ ✧ ✦

"THIS industrial show will be the largest ever held in America," Mr. Eisenman said. "Because of the widespread advance interest in the Metal Exposition, the floor plans which have been mailed to previous exhibitors this week showed a greater area of exhibit space than any event of this type in the history of U. S. industrial shows."

✦ ✦ ✦

"THIS interest in the Exposition indicates that manufacturers are ready for reconversion and eager for the opportunity to show the new machines, materials and processes that have been developed in war and to demonstrate their possibilities for high peacetime production," Mr. Eisenman continued.

✦ ✦ ✦

"FOR the first time in four years," he added, "the Metal Show, as it is generally known in industry, will be a forthright effort on the part of exhibitors to sell their products."

✦ ✦ ✦

MR. **Eisenman** pointed out that the Exposition would again be held in conjunction with the National Metal Congress with the result that thousands of metal men will not only see all the new products in operation at Public Auditorium but will also have the opportunity to hear the outstanding research papers presented by scores of engineers and technical experts. Cooperating with the American Society for Metals in presenting the Metal Congress will be the Amer-

ican Welding Society, the Iron and Steel and Institute of Metals divisions of the American Institute of Mining and Metallurgical Engineers, and the American Industrial Radium and X-Ray Society. Many trade associations and industry groups will also meet in Cleveland during the week of this event.

Gaging of Precision Holes

GAGING of precision holes is discussed in Bulletin No. 31 describing the "Shock-Absorbing Comtorplug Internal Comparator" just released by **The Comtor Co.**, Waltham 54, Mass. Contents include: description of the unique comtorplug principle of gaging precision holes, to fractions of .0001", providing automatic self-alignment and self-centering of this expanding plug gage; illustrations of Comtorplugs in use on actual work gaging holes in various products and parts; description of the sizes and capacities from ¼" diameter to 8" diameter and larger, also special types with extended inreaches up to 17" or more; explanation of the interchangeability of all plugs in any amplifier; description of the shock-absorbing construction which suits Comtorplug to use by machine operators and bench inspectors as well as final laboratory inspectors; a complete list of sizes and prices. Copies may be obtained by requesting "Bulletin No. 31."

✦ ✦ ✦

"Catalytic Chemistry"

THIS new book by **Henry William Lohse**, Ph.D., F.C.I.C., consulting chemist, is a factual presentation of the underlying principles in catalytic phenomena and the applications of catalytic reactions in industrial processes.

✦ ✦ ✦

A SEPARATE section is devoted to each of the various types of catalytic reactions, and the nature and properties of catalysts in industrial catalytic reactions are discussed in detail.

✦ ✦ ✦

PARTICULAR attention is paid to the presence of impurities in catalytic reaction systems and to the role of traces of other metals in silver, copper, iron, nickel, etc., used as catalysts.

✦ ✦ ✦

THE book, published by Chemical Publishing Company, Inc., Brooklyn 2, N. Y., sells for $8.50 per copy.

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STATEMENT OF OWNERSHIP, management, circulation, etc., required by the Acts of Congress of August 24, 1912 and March 3, 1933, of Wire & Wire Products published monthly at Stamford, Conn., for October 1, 1945.

State of Connecticut, County of Fairfield, ss.: Before me, a Notary Public in and for the State and county aforesaid, personally appeared Richard E. Brown, who, having been duly sworn according to law, deposes and says that he is the President of Wire & Wire Products and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publishers, editor, managing editor, and business managers are:

Publisher, Quinn-Brown Publishing Corporation, 300 Main St., Stamford, Conn.; editor, Richard E. Brown, 300 Main St., Stamford, Conn.; managing editor, none; business manager, Richard E. Brown, 300 Main St., Stamford, Conn.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Quinn-Brown Publishing Corporation, 300 Main St., Stamford, Conn.; Richard E. Brown, 300 Main St., Stamford, Conn., Leta B. Brown, Montecito, California, and Ruth S. Spengel, Shore Front Park, South Norwalk, Conn.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

RICHARD E. BROWN
(Publisher)

Sworn to and subscribed before me this 21st day of September, 1945.

(SEAL) WILLIAM A. MURPHY,
Notary Public.

My commission expires April 1, 1949.

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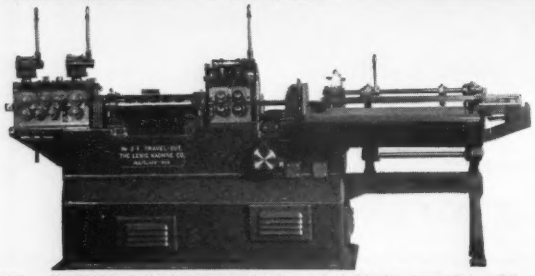

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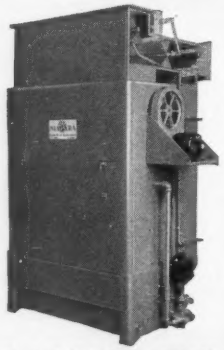

U. S. Patent Nos. 2,296,946, 2,321,933 & Re-issue No. 22,553.

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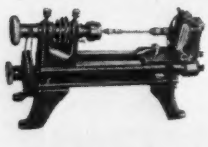

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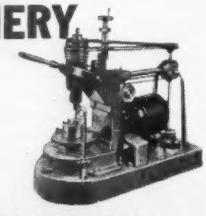


ROOS TOOL & MFG. CO. 17-19 GROVE ST., MONTCLAIR, N. J.

Elastic Properties of Steel Wire Intended for Springs and Formed Parts

(*Continued from page 861*)

with these properties could be formed easily and the finished form held to close tolerances. Bluing after forming would raise the yield point to 85-90% of the tensile strength. In other words a heat setting plastic wire would be ideal. The nearest approach to this state is illustrated by chart 5 made from a series of tensile tests on .092 dia. X1055 hard drawn wire. The yield on the wire after straightening and before bluing was 64% of the tensile and bluing at 500° raised the yield to 90% of the tensile. Chart 6 serves to illustrate the behavior of music wire under the same conditions of test. Experimental work towards this end, because of the facilities required, should be done by the wire producers and it is respectfully suggested that they take action. The development shouldn't be too difficult as all of our wire sources have unintentionally produced the type of wire described from time to time and all that is necessary is to find out what happened and arrange to have that variable made a constant.

✦ ✦ ✦

John Frye Sales Manager, Columbia Steel & Shafting Co.

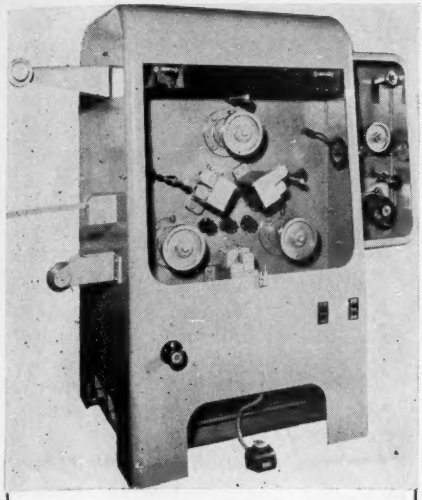
John H. Frye has been appointed general manager of sales of Columbia Steel & Shafting Company.

✦ ✦ ✦

MR. Frye has been associated with the company since 1927 as manager of sheet sales at Detroit, and metallurgical engineer at Pittsburgh. For the last five years he has been on leave of absence, serving as Colonel of Ordnance, U. S. Army. He entered the service as consultant to Major General G. M. Barnes on metallurgical matters. Later he served as Assistant Chief, Research and Material Division, Research and Development Service, Office of Chief of Ordnance.

✦ ✦ ✦

MR. Frye is a member of the Society of Automotive Engineers and the American Society of Metals. He has written several papers on metallurgical developments during the war.



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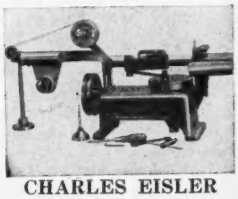

Bench Type Butt Welder

CHARLES EISLER
EISLER ENGINEERING CO., 747 So. 13th St., near Avon Ave., Newark 3, N.J.

A Chronology of Wire & Wire Products

(*Continued from page 866*)

cal and triangular strands intermixed.

Craven and Speeding put on market rope invented by Mr. Westgarth.

American Steel and Wire produced 285,039 tons of woven wire fencing.

1911 Sleeper and Hartley, of Worcester, Mass., started in the manufacture of wire coiling machinery.

1913 P. Longmuir and J. Kenworthy write article on "History of Wire Drawing," in "Engineering," v. 95, p. 540-3, April 18 (England).

1914 The American Society for Testing Materials instituted an elaborate series of tests in different parts of the country to study resistance to corrosion of various materials.

1917 Heyman Rosenberg patents the self-tapping screw.

1919 In England a machine was designed to salvage barbed wire from battle fields.

The Census of the U. S. establishes that there are 108 establishments drawing wire.

1922 Galvannealing process for galvanizing wire and strip patented (1,430,651).

1923 Conners of Bridgeport, Conn., patented Trilay preformed wire rope.

1924 Aug. 31, German patent 438,275 on reactive drawing of wire.

G. Soliman's book published: "Principles generaux de l'etirage et du trefilage."

1925 H. Dunnell's book on "British Wire Drawing and Wire Working Industry" published.

R. Papier: "Essai sur le trefilage" (Essay on drawing).

O. H. Dohner: "Geschichte der Eisendraht Industrie" (History of of the Wire Industry).

1926 Friedrich Krupp starts to produce Widia.

First number of WIRE AND WIRE PRODUCTS appears.

H. Altpeter publishes: "Die Herstellung der Fluszeisen und Stahldrahte" (The Production of Iron and Steel Wire).

1927 G. de Latre publishes book.

H. Goldschmidt pub'ishes: "Das Drahtziehen auf Mehrfachziehmaschinen, 1st ed. (Wire Drawing on Multiple Draw Machines).

1928 Carbide dies introduced in wire industry in U. S.

1929 WIRE ASSOCIATION organized.

World's largest airship the R100 built, it used some 22 miles of wire rope.

Music records made on wire thread and patents held by the British Filograph Co., Ltd.

Nepal ropeway from Katmandu and the Indian frontier completed over 14 miles in Himalaya country.

Western Union Telegraph opened to public use new cable between New Foundland and the Azores covering 1,341 nautical miles. This cable permitted sending 4 messages in each direction simultaneously by use of mumetal (Ni, Co, Fe). Cost of cable reached two million dollars.

(*Please turn to page 886*)

How to Save Acid . . . Reduce fumes in Pickling

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CLEVELAND, OHIO

A Chronology of Wire & Wire Products

(Continued from page 885)

M. Boerner publishes his "Drahtweltbuch" (Wire World Handbook).
Dr. J. F. Wall at Sheffield developed an electro magnetic method of testing wire ropes in situ for internal flaws.
Emil Tages of Neustad on Orla put wire mesh machines on market which revolutionized German wire mesh production.
Total value of wire and wire products made in 1929 for sale by manufacturers in the U. S., $884,460,174.

1930 Wire drawing plants in the U. S., 132, wire products fabricating plants using purchased wire, 512, with a total of 644.
WIRE ASSOCIATION founded.
Introduce submerged burners in pickle room.
Aston of wrought iron developed.

1931 U. S. wire and wire products industry valued at $403,598,789.
Use of Thyratron tube to maintain tension as wire is reeled.
Ramet (TaC) dies introduced in wire industry.
The Blattner "Stillephone" developed by Dr. Stille used by British Broadcasting Corp. in some London theatres. Sound recorded electrically on a thin wire passing between electromagnets and rolled on a spool.

1932 H. Goldschmidt presents 2nd ed. of his "Das Drahtziehen auf Mehrfachziehmaschinen.
Wire Industry Preparedness Plan for National Defense by R. E. Brown in the July, vol. 7, No. 7 issue of WIRE AND WIRE PRODUCTS.
Direct gas fired system for rod baking introduced.

1933 J. L. Schueler, U. S. patent 1,936,487, is granted patent on adjustable device for regulating the amount of molten coating remaining on the material and flame treatment is provided for unfirmly distributing the coating material.
Bethanized wire put on market.
Process of electrogalvanizing wire developed by U. C. Tainton, use roasted ore, high current density plus high acid electrolyte. (U. S. 1,972,835).

1934 M. Bonzel publishes: "Le trefilage de l'Acier" (Steel Wire Drawing).
Wire Industry, the English publication appears.
Cleaning in molten salt developed by Tainton, wire is made the cathode.

1935 H. A. Stringfellow investigated and made research on back pull drawing from which the reactive wire drawing method developed. Lindberg Cyclone Tempering furnace introduced.
K. B. Lewis publishes his translation of M. Bonzel's "Steel Wire, Manufacture and Properties."

1936 R. H. Phelps complies: "Iron and Steel Wire, a Bibliography. Carnegie Library of Pittsburgh.
A. T. Adam: "Wire Drawing and the Cold Working of Steel," 2nd ed.
Flash Baker for rod wire developed.

1937 E. A. Smith writes on certain phases of the history of wire in Wire Industry (London) vol. 4, p. 263.
Dr. C. G. Fink patents method of aluminum coating steel wire "Alplate." (U. S. 2,082,622).

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With a Porter cutter you can cut hard wire (with center cut round edge jaws), spring wire, wire fabric, tie wire — anywhere, easily and quickly.

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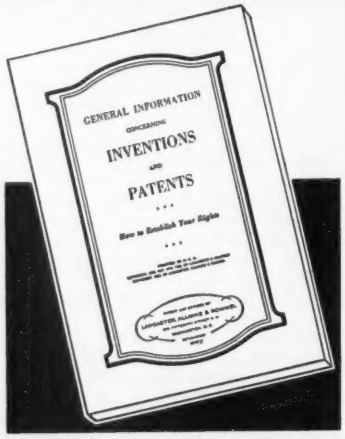

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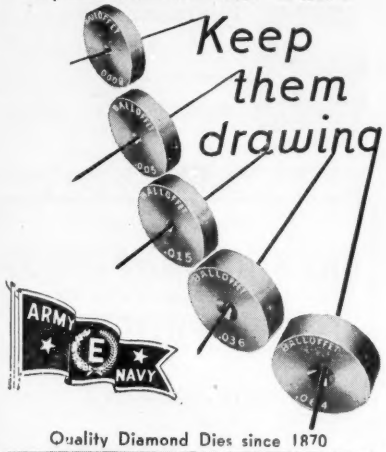

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1938 "An Early History of Wire Drawing. Processes in the 1840" abstracted from Bechman's Wire Industray, vol. 5, p. 612 & 671.
H. Altpeter publishes 2nd ed. of his "Die Herstellung der Fluszeisen and Stahldrahte."

1939 J. L. Herman obtains patent on novel method of galvanizing wire (2,166,250).

1940 T. Sendzimir obtains patent 2,110,-893 on methods of coating strip after passing thru furnaces with oxidizing and reducing atmospheres followed by hot dipping.

1941 A. Pomp publishes: "Stahldraht. Seine Herstellung u Eigenschaften" an extensive review of which can be found in Wire and Wire Products for Sept, 1943, p. 513.

1942 "The Origin and Manufacture of Wood Screws," article by N. Dickinson, Wire Industry, vol. 9, p. 73.
L. H. Winkler obtains U. S. patent 2,288,762 on zinc plating rods or wire and then drawing them down to desired gage and zinc thickness, to be used especially on cable wire.

✦ ✦ ✦

New Rinsing and Drying Machine

A NEW machine especially designed for the rinsing and drying of screw machine or small stamped parts, has been announced by **Optimus Equipment Company,** 251 Church Street, Matawan, N. J., manufacturers of equipment for the washing, rinsing, pickling and drying of metal parts.

✧ ✧ ✧

THE **Optimus** Screw-Drum Type Machine is versatile in its applications. It can be used for washing and drying, or rinsing and drying, or any part of these operations. It is also adaptable to a wash-drain, rinse-drain, cold or hot air dry operation sequence.

✦ ✦ ✦

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✦ ✦ ✦

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New Cable Developed For Airplanes

AMERICA'S airplanes of the future are going to have more flexible and efficient "muscles" as the result of a development recently perfected by technicians of the **American Steel & Wire Co.**, subsidiary of United States Steel Corp. The "muscles" of all planes are thin steel cables made up of fine wire which enable the pilot to manipulate the rudder and ailerons of his ship in much the same way that the muscles running down the human arm energize the hand and fingers.

✦ ✦ ✦

THE newly-developed cable performs the same functions as former types and banishes a number of aircraft engineering difficulties in one sweeping stroke by having the ability to expand and contract in varying temperatures at almost the same rate as duralumin. The virtual elimination of this discrepancy between the two metals has done away with special compensating devices and at the same time has contributed to the efficiency of both the pilot and his plane.

✦ ✦ ✦

BECAUSE they are concealed beneath the skin of the plane, control cables are often overlooked by the casual observer. However, their importance cannot be minimized and they represent one of the many uses of steel in aircraft and one which cannot be performed satisfactorily by any other metal.

✦ ✦ ✦

FOR the most part these cables have been made of plain carbon steel, although in some applications where extreme corrosion or temperature factors must be overcome, stainless was used. Steel is the only material which has sufficient tensile strength and the ability satisfactorily to resist wear at points of contact with pulleys to perform this vital task. However, steel has a different coefficient of expansion than has duralumin, of which the frame of a plane is constructed. The result is that when a plane passes from temperatures at ground level to the subzero temperatures of high altitudes, the frame contracts to a greater degree than the ordinary control cables

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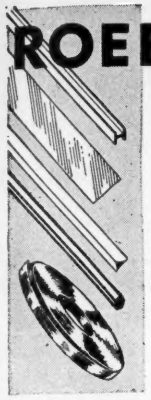

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thus creating slackness in the cables and sluggish control of the ship. In passing from a temperature of 70° F. to —70° F., for instance, in a running length of 70 ft. the airframe of a plane will contract approximately ¾" more than the carbon steel control cable. Failure to compensate for the varying cable lengths assumes tremendous importance when it is considered that a B-17 Flying Fortress contains 3,000 feet of control cables, while the new giant B-29 Superforts have considerably more spreading to all parts of the ship. This discrepancy had to be overcome by the use of temperature compensating devices in the control system which automatically took up the slack. However, these devices created added weight to the plane and their delicate and complicated construction demanded frequent servicing and attention, which were not always available in some areas.

✦ ✦ ✦

THE steel in the new control cables is a high nickel manganese alloy formerly used for making hold-down devices for aluminum housings. Because of the special analysis of the material, it requires an entirely different practice in wire drawing technique to effect utilization of its maximum beneficial properties. Only after many months of work and experimentation was production of the material made possible through development of these drawing procedures, together with special closely-controlled heat treatments.

✦ ✦ ✦

ALL types of aircraft control cables are being produced from the new material in American Steel & Wire plants. They range from a single strand of 7 wires, where a degree of rigidity is desired, to 7 strands of 19 wires each—a total of 133 fine wires —where a maximum of flexibility is demanded. Sizes range from 1/32" to ¼" diameter.

✦ ✦ ✦

THE net results are not only considerable weight savings due to the elimination of the compensating equipment, but more satisfactorily and efficient handling of the plane by the assurance of contant tension. The

(*Pease turn to page 890*)

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New Cable Developed Furnaces

(*Continued from page 889*)

development has removed the necessity for extreme rigging tensions, which in many cases increase the friction losses in the system to a point where actual control of the plane imposes pilot fatigue more rapidly than is justifiable.

✦ ✦ ✦

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✦ ✦ ✦

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✦ ✦ ✦

THE first allotment of the calculators have been distributed to all Auto-Lite Registered Service Dealers.

✦ ✦ ✦

New Catalog Describes Electric Furnace

THE "40th Anniversary Catalog No. 108" of "Certain Curtain" Controlled-atmosphere Electric Heat-treating Furnaces is announced by **C. I. Hayes, Inc.,** Providence 5, R. I. Described are furnaces for hardening high speed steel and carbon, alloy and stainless steel tools and dies; annealing; copper brazing; tungsten, carbide tool tip brazing; sintering metal powders; conveyor hardening, annealing and brazing; verticle heat heating; tempering; melting; also auxiliary atmosphere generating and recirculating equipment. Included is a section devoted to Furnace Atmosphere Control, containing recommended atmospheres for a wide variety of standard brands of steel, together with manometer tables for obtaining desired atmospheres with various types of gas.

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✦ ✦ ✦

THIS 16MM film with sound commentary has been prepared in English, French, Russian and Spanish for preliminary distribution. Its 26 minute run gives a popular Hollywood style portrayal of the many applications of the "swaging process" in today's mass production methods for pointing, shaping, and attaching fittings to bar, cable and tube.

✦ ✦ ✦

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✦ ✦ ✦

STEEL — including stainless — copper, aluminum and even wood products are shown by the film to be included within the processing scope of the Swager and its derivatives.

✦ ✦ ✦

THE movies has been made available without charge by the **Standard Machinery Company** of Providence, Rhode Island, where this and a short U.S. Office of Education movie on swaging were filmed. The educational film has been incorporated in the complete "Standard" film.

✦ ✦ ✦

COPIES of the film can be reserved for local showings with Maxwell-Roney, 35-36 76th Street, Jackson Heights, Long Island; The Swind Machinery Company, Philadelphia, Pennsylvania; Wm. K. Stamets Company, Pittsburgh, Pennsylvania and Cleveland, Ohio; Neff Kohlbusch & Bissell, Inc., Chicago, Illinois; Smith Booth Usher & Co., Los Angeles, California; and for export showings with Mr. Stanley H. Rose, 1111 South Ferry Building, New York, New York.

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WHERE TO BUY

For more complete information, consult the annual Wire and Wire Products Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ACID INHIBITORS—
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

ACID-PROOF CONSTRUCTION—
Ceilcote Co., The, Cleveland, Ohio
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio
Nukem Products Co., Buffalo, N. Y.
Sauereisen Cements Co., Pittsburgh, Pa.

AIR DRAW FURNACES—
Carl-Mayer Corp., The, Cleveland, Ohio.

ALKALINE CLEANERS—
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.

ANNEALING MACHINES—
Open Flame
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

BAKERS—Flash
Morrison Engineering Corp., Cleveland, Ohio

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Corp., Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio.

BELTS—Wire
Wickwire Spencer Steel Co., New York, N. Y.

BENDERS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES & SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BRICKS—Acid Proof
Keagler Brick Co., Steubenville, Ohio.
Nukem Products Co., Buffalo, N. Y.

CABLE LACQUERING OVENS
Industrial Oven Engr. Co., Cleveland, Ohio.

CABLE—Steel and Copper
Bethlehem Steel Co., Bethlehem, Pa.
Brewer Mfg. Co., Williamsport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Wickwire Spencer Steel Co., New York, N.Y.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.

CASTINGS—Wire Mill
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

CEMENTS—Acid Proof
Sauereisen Cement Co., Pittsburgh, Pa.

CEMENTS—Refractory
Babcock & Wilcox Co., The, New York, N.Y.
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIP.
Broden Construction Co., Cleveland, O.
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Haveg Corporation, Newark, Del.
Heil Engineering Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Nukem Products Corp., Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH TESTERS—
Scott Testers, Inc., Providence, R. I.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Spencer Steel Co., New York, N. Y.

COATING COMPOUNDS—
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

COLD HEADERS—
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Shell Oil Co., Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Shell Oil Co., Inc., New York, N. Y.
Standard Industrial Compounds, Inc., Chicago, Ill.

COMPOUNDS—Wire Drawing
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Shell Oil Co., Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CONTROLS—Heat Treating
Niagara Blower Co., Buffalo, N. Y.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Michigan Wire Die Co., Detroit, Mich.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vianney Wire Die Wks., New York, N. Y.

DIAMOND POWDERS—
Michigan Wire Die Co., Detroit, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
United Die Co., Newark, N. J.

DIAMOND TOOLS—
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Michigan Wire Die Co., Detroit, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
United Die Co., Newark, N. J.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies Co., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hartley Wire Die, Thomaston, Conn.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Michigan Wire Die Co., Detroit, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Michigan Wire Die Co., Detroit, Mich.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Tungsten Electric Corp., Union City, N. J.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp, New York, N. Y.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Luginbill Wire Die Co., Fort Wayne, Ind.
Michigan Wire Die Works, Detroit, Mich.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Tungsten Electric Corp., Union City, N. J.
United Die Co., Newark, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.
Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Hubbard Spool Co., Chicago, Ill.
Stevens Metal Products Co., Niles, Ohio.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

DRYING & PRE-HEATING ROOMS
Carl-Mayer Corp., Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.

DRYING EQUIPMENT
Carl Mayer Corp., Cleveland, Ohio.

ENGINEERS—Consulting Wire Mill
Aufhauser Brothers Co., New York 5, N. Y.
Lewis, Kenneth B., Worcester, Mass.
Wiel, L D., New York, N Y.

EQUIPMENT—Humidifying
Niagara Blower Co., Buffalo, N. Y.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn
Entwistle, James L., Co., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FENCES AND FENCING—Wire
Wickwire Spencer Steel Co., New York, N.Y.

FIREBRICK—Insulating
Babcock & Wilcox Co., The, New York, N.Y.

FIREBRICK REFRACTORIES — Brick and Cement
Babcock & Wilcox Co., The, New York, N. Y.

FLASH BAKER—
Morrison Engr. Corp., Cleveland, Ohio

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa
Parkin, Wm. M., Co., Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Oven Engr. Co., Cleveland, Ohio.

WHERE TO BUY, Continued

FURNACES—Annealing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Eisler Engineering Co., Newark 3, N. J.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Galvanizing Equipment
Electric Furnace Co., Salem, Ohio
Furnace Engineers, Inc., Pittsburgh, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Surface Combustion Corporation, Toledo, O.
Wilson, Lee, Engineering Corp., Cleveland, Ohio

FURNACES—Hard'ing & Temp'ing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Robertson, John, Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Salt Bath
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corporation, Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Morrison Engineering Corp., Cleveland, Ohio
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Galvanizing Equipment
Furnace Engineers, Inc., Pittsburgh, Pa.
Wilson, Lee, Engr. Co., Cleveland, Ohio

GALVANIZING KETTLES
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., Worcester, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
Industrial Oven Engr. Co., Cleveland, Ohio.

INSULATING MATERIALS—
Angier Sales Corp., Framingham, Mass.
Crepe-Kraft Co., Newark, N. J.
Standard Varnish Works, Staten Island, N. Y.

KETTLES—Galvanizing, Annealing, Tinning, etc.
National Annealing Box Co., Washington, Penna.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Hartley Wire Die, Thomaston, Conn.
Morgan Construction Co., Worcester, Mass.
Roos, H. & G., Tool & Mfg. Co., Montclair, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry & Machine Co., Waterbury, Conn.

LININGS—Acid and Alkali Proof
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Coil Wrapping
Angier Sales Corp., Framingham, Mass.

MACHINERY— Coilers
Broden Construction Co., Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
American Insulating Mach'y Co., Phila., Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Lewis Machine Co., The, Cleveland, Ohio.
Moslo Machinery Inc., Cleveland, Ohio.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Porter, H. K., Inc., Everett, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Die Making
Carboloy Co., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Roos, H. & G., Tool & Mfg. Co., Montclair, N. J.

MACHINERY—Draw Benches
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging
Broden Construction Co., Cleveland, Ohio.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Oven Engineering Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Fence
Broden Construction Co., Cleveland, Ohio
Glader, Wm., Machine Works, Chicago, Ill.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark 3, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY— Forming
Eisler Engineering Co., Newark 3, N. J.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Galvanizing
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Brockton, Mass.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.

WHERE TO BUY, Continued

MACHINERY—Nail and Tack
Broden Construction Co., Cleveland, Ohio.
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Quill Winding
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio.
Emory, Robert J., Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark 3, N. J.
Emory, Robert J., Co., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington M'g. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, Ohio.
Lewis Machine Co., The, Cleveland, Ohio.
Moslo Machinery Co., Cleveland, Ohio.
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L., Electric Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.

MACHINERY—Testing Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co, Torrington, Conn.

MACHINERY—Welding Wire
Aufhauser Brothers Co., New York 5, N. Y.
Eisler Engineering Co., Newark 3, N. J.
Micro Products Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark 3, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY — Wind-up (Constant Tension, Variable Speed
Industrial Oven Engr. Co., Cleveland, Ohio.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark 3, N. J.
Nilson, A. H., Co., Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio.
Eisler Engineering Co., Newark 3, N. J.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Inc., Brockton, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co. Torrington, Conn.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburg, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

OILS—Wire Drawing
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Shell Oil Co., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Philadelphia, Pa.
Industrial Oven Engr. Co., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, O.

OVENS—Dehydrogenizing
Carl-Mayer Corp., Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.

OVENS—Industrial
Carl Mayer Corp., The, Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio.
Industrial Oven Engr. Co., Cleveland, Ohio.
Morrison Engineering Corp., Cleveland, O.
Moslo Machinery Co., Cleveland, Ohio.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAINTS—Marine
American Chemical Paint Co., Ambler, Pa.

PAINTS—Structural Steel
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Corrosion Preventive
Angier Sales Corp., Framingham, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER—Insulating
Angier Sales Corp., Framingham, Mass.
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott Testers, Inc., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

PICKLING TANK LININGS—
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.
Keagler Brick Co., Steubenville, Ohio.
Sauereisen Cement Co., Pittsburgh, Pa.

PIPES & FITTINGS—Acid Resistant
Ceilcote, The, Co., Cleveland, Ohio
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

POTS—Lacquer
Industrial Oven Engr. Co., Cleveland, Ohio.

POTS—Lead Melting
National Annealing Box Co., Washington, Pa.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

WHERE TO BUY, Continued

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Industrial Oven Engr. Co., Cleveland, O.
Moslo Machinery Co., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Takeoff
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Stevens Metal Products Co., Niles, Ohio.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

REELS—Wooden
Bridge Mfg. Co., Inc., The, Hazardville, Conn.

REFRACTORIES—High Temperature
Babcock & Wilcox Co., The, New York, N.Y.
Norton Co., Worcester, Mass.

REFRACTORIES—Insulating
Babcock & Wilcox Co., The, New York, N.Y.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Morrison Engr. Corp., Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Spencer Steel Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLL STRAIGHTENERS—
Moslo Machinery Co., Cleveland, Ohio.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Brewer Mfg. Co., Muncy, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Spencer Steel Co., New York, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.

RUST REMOVING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Heil Engineering Co., Cleveland, Ohio
Standard Industrial Compounds Co., Chicago, Ill.

SATURATION SYSTEMS—
Industrial Oven Engr. Co., Cleveland, Ohio.

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

SOAPS—Industrial and Wire Drawing
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Potter, Neil C., Newark, N. J.
Shell Oil Co., Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Oven Engr. Co., Cleveland, Ohio.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, Ohio.

SPRINGS—Steel
Wickwire Spencer Steel Co., New York, N. Y.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRAND—Steel and Copper
Brewer Mfg. Co., Williamsport, Pa.
Wickwire Spencer Steel Co., New York, N. Y.

STRIP—Brass and Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Spencer Steel Co., New York, N.Y.

STRIP METAL TESTERS—
Scott Testers, Inc., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANK LININGS—Brick
Ceilcote Co., The, Cleveland, Ohio.
Keagler Brick Co., Steubenville, Ohio.
Nukem Products Corp., Buffalo, N. Y.

TANKS—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Engineering Co., Cleveland, Ohio.
Nukem Products Corp., Buffalo, N. Y.
Sauereisen Cements Co., Pittsburgh, Pa.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.
National Annealing Box Co., Washington, Pa.

TESTING INSTRUMENTS—
Davis, R. L., Electric Co., Wallingford, Conn.
Scott Testers, Inc., Providence, R. I.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

TRAVERSES—
Hubbard Spool Co., Chicago, Ill.
Stevens Metal Products Co., Niles, Ohio

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Roesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—Friction and Power
Standard Machinery Co., Providence, R. I.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—For Insulation
Standard Varnish Works, Staten Island, N.Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark 3, N. J.
Micro Products Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y Co., Philadelphia, Pa.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Oven Engr. Co., Cleveland, Ohio.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A. Sons, Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled for Coils
North American Philips Corp., Dobbs Ferry, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A. Sons, Co., Trenton, N. J.
Spencer Wire Co., West Brookfield, Mass.
Wickwire Spencer Steel Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Spencer Wire Co., West Brookfield, Mass.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.

WIRE—Non-Ferrous to Specification for Special Purposes
Hudson Wire Co., Ossining, N. Y.
North American Philips Corp., Dobbs Ferry, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Spencer Steel Co., New York, N. Y.

WIRE—Stainless Steel
Firth-Sterling Steel Co., McKeesport, Pa.
Spencer Wire Co., West Brookfield, Mass.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester 1, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Spencer Wire Co., West Brookfield, Mass.
Wickwire Spencer Steel Co., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott Testers, Inc., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Newark, N. J.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

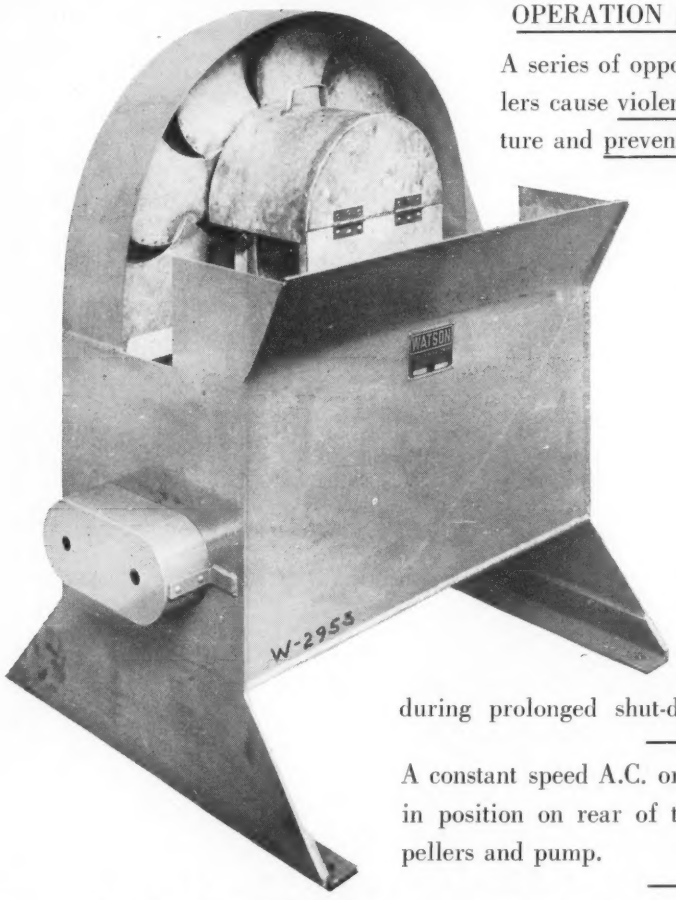
The WATSON MACHINE COMPANY
ESTABLISHED 1845
PATERSON, NEW JERSEY, U. S. A.

Wire & Wire Products
November, 1945

ELECTRICAL WIRE AND CABLE AND WIRE ROPE MACHINERY

"Wet" CHALKER

Thorough mechanical AGITATION and an entirely new PUMP SYSTEM are the outstanding advantages offered in this latest design.



OPERATION and CONSTRUCTION.

A series of opposed motor-driven impellers cause violent turbulence in the mixture and prevent settling of the heaviest powder materials.

A bucket-wheel pump, ever free from mechanical troubles, scoops the mixture at the point of greatest turbulence and feeds it into the immersion trough through which cable passes. The buckets are "self-draining" to prevent settling and caking of materials during prolonged shut-down periods.

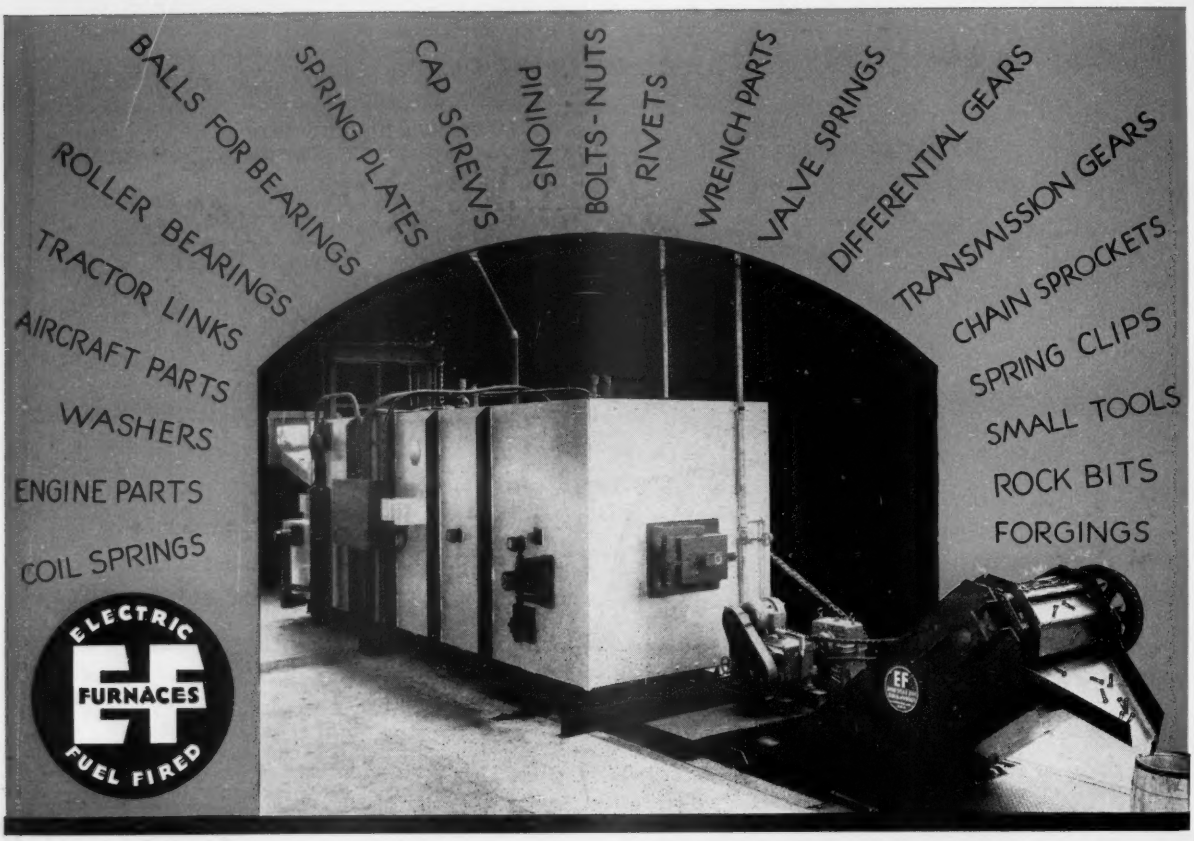
A constant speed A.C. or D.C. motor is mounted in position on rear of tank. It drives both impellers and pump.

User provides "split" wooden gates cut on band-saw with oversize hole for cable passage, permitting removal of cable from tank at any time.

Unit shown on cut, W-2953, passes cables of up to 5" diameter and is equipped with a 1 H.P. polyphase squirrel cage motor. It is arranged for 40" Cable Center Height from Floor to suit our Cable Armoring Machines, but prospective users specify desired height for other uses.

* * *

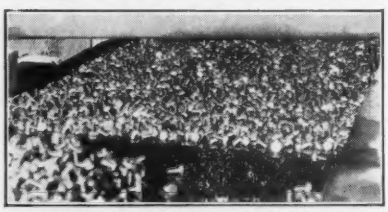
Also available are "Dry" powder applicators in various types and sizes.



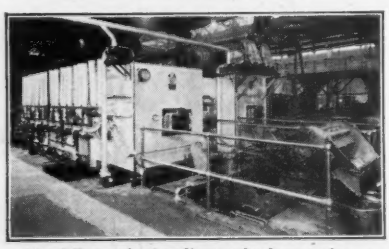
For Hardening Small Parts

175 to 2000 lbs. per hour

Uniformly—Scale-free—Continuously



Charging end of EF chain belt furnace showing cap screws loaded directly on conveyor—no pans or trays are used—100% net material.



This EF gas fired radiant tube furnace is one of 3 chain belt furnaces we insialled in one plant. The furnace shown at top of page is electrically heated.

The EF Chain belt conveyor furnace is one of tha most satisfactory and dependable general purpose heat treating machines built for the continuous, uniform, economical, production heat treatment of miscellaneous small and medium sized parts and products.

These furnaces handle all kinds of parts and products ranging in size from small bolts and springs up to large crawler links for tractors. Hundreds are in operation handling such products as listed above.

EF continuous chain belt conveyor furnaces may be oil fired, gas fired, or electrically heated. They are built in several sizes with capacities ranging from 175 to 2000 lbs. per hour. Larger or smaller sizes can also be furnished. Any size can be built for using special protective atmospheres for heat treating without scale or decarburization.

The chain belt conveyor furnace is only one of the numerous types we build. Wire, tubing, strip, castings, forgings, stampings, aircraft and automotive engine parts, and many other products are being uniformly treated in other types of EF production furnaces.

Write us regarding your furnace problems. We specialize on building production furnaces.

Send for circulars showing the chain belt and other types of EF production furnaces

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces - - - For Any Process, Product or Production